Soil mixtures

		Pots	Cultures
1.	Peat 8 parts Sand 1 part Loam 1 part	Whiskey glasses 56	73
2	Mixture 1 2 part Manure 1 part	Whiskey glasses 6	74
3	Mixture 1 4 parts Manure 1 part	Whiskey glasses 6	75
4	Mixture 1 99% Lime 1%	Whiskey glasses 6 Peat 8 " " Sand 1 " " Loam 1 " " Lime 8 cc.	76
5	Rose soil	Whiskey glasses 18	77
6	Sand	Whiskey glasses 12	78, 79
7	Peat	Whiskey glasses 6	80.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

OFFICE OF
TAXONOMIC INVESTIGATIONS.

Washington Jan. 11, 1909

Cultures 73 & 74. In all the plants of Culture 73 the terminal rudiment has withered, and the roots have all made excellent growth. In 74, all the leaf tips are growing, but none of the roots have put out any new growth. Incidentally this illustrates the value of transparent pots.

Culture 78. Root growth in all excellent, stem tips withered in 3, rather dormant in 2 others.

Culture 79 Root growth excellent in all, stem tip withered in 4, dormant in 2

Culture 80 Root growth good, though less than in 73, 78, and 79, stem tips withered in 2, growing in the others.

Culture 75. Roots growing a little in all but one, in that none. Leaf tips growing in all

Culture 75A Roots growing fairly well, about as in 80, leaf tips growing in all but one, in that withered but the new bud developing rapidly.

Culture 76. Root growth very feeble, stem tips bad in

Culture 77. Root growth none or very feeble, stem tips dead in 4

Jan. 12, 1909

Culture 90. Tips withered as follows:

C_2 E_2 G_1 $H_{1,4}$ $I_{1,2}$ K_4 L_4

The tip of J 3 has been eaten off by an insect. The leaf rudiment in many of the plants is stagnant.

Culture 89 Tips withered as follows:

$B_{1,2,3}$ $C_{1,2,3}$ D_2 E_4 $F_{1,3}$ H_3 $J_{1,4}$ $K_{1,3,4}$

In J1 the tip withered after the development of the first new leaf.

Culture 69. A few of the seedlings beginning to show the rudiment of the first, hairy leaf.

Culture 70. Over the part of the flat still naked there has been no recent germination of seeds. Over the part covered with live whole sphagnum 8 seedlings have germinated since the sphagnum was put on. These and the older plants are growing slimmer than those in the open. Underneath the moss ~~the green~~ algal layer ~~has been~~ ~~is being~~ replaced in parts by a dark brown layer of dead organic matter consisting of the excrement of some minute animal. Apparently the algal layer is being eaten.

Jan. 12, 1909.

Experiment

Try the relative osmotic ~~effect~~ pull in the soil solution of Kalmia peat (Culture 80) and Kalmia peat & loam 1 and sand 1 (Culture 73) as opposed to a heavily manured soil (Culture 74) to ascertain whether the withering of the leaf tip in 73 and 80 and its continued growth in 74 is not correlated with a greater difficulty in 73 and 80 in getting water for transpiration purposes.

Jan. 13, 1909.

Cultures 74, 75, 75A. It is to be noted that in all these cultures containing manure all the plants except one isolated individual in 75A have [illegible] magnifying the growth of life ~~not lost their young life by~~ and have not lost them by ~~[illegible]~~ withering as has happened in many or all of the plants in the sand, peat, lime, rose, ~~[illegible]~~ and blueberry soils.

(See recent records for Cultures 73, 76, 77, 78, 79, 80, 89, 90.

UNITED STATES DEPARTMENT OF AGRICULTURE,
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Jan. 14, 1909.

An important discovery was made [illegible] with [illegible] to the character of the kalmia peat that must be used for growing ~~the~~ *Vaccinium corymbosum* successfully. In all the cultures from 43 to 53 growth has been excellent, and the leaf rudiment at the tip of the stems has not withered after transplanting. In all the peat cultures from 54 onward growth has not been good, the ultimate leaf rudiment commonly stops [illegible] after transplanting [illegible] in a [illegible] withered, a [illegible] [illegible] of [illegible] became prevalent [illegible] [illegible] leaves, [illegible] such plants as developed new growth the leaves are small.

Cultures 43 to 53 were potted Nov. [illegible] or earlier, [illegible] 54 [illegible] ones November 24 or later. [illegible] on November 15 that the first load of new peat was delivered at the greenhouses. Cultures [illegible] 53 were potted in peat that [illegible] under the shed from the [illegible] 54 and later in [illegible] year, [illegible] from unrotted peat.

[illegible] the decomposed peat [illegible] into the [illegible] layers of unrotted leaves. In [illegible] [illegible] leaves and [illegible] our [illegible] the [illegible] rubbed [illegible] a sieve [illegible]

[illegible] 4 [illegible]

A 2 — A_4 Withered Jan. 17, [illegible] leaves, branches 3.5 + [illegible] cm, cotyledonary

A 3

B 3 — C_1 Withering Jan. 16, withered Jan. 17, 18 leaves, shoot 8.0, cotyledonary
C_4 " " " , " " " 14 leaves, shoot 4.5, [illegible]

D_2 Withering Jan. 17, [illegible] Jan. 18, 15 leaves, shoot 2.7 cm, from first and second axils
E_3 Withered Jan. 17, 20 leaves, shoot 4. cm, from first axil
[illegible] Jan. 15, withered Jan. 16, 16 leaves, [illegible] 4.5 cm, from first axil
E_1 withering Jan. [illegible], 16 leaves, shoot 4.5 cm, third axil
E_3 " " " 17 leaves, shoots 1. + 1.5 cm, first and second axils

A 1

A 2 — [illegible] withering Jan. 15, withered Jan. 16, 11 leaves, branch 3 cm, cotyledonary

[illegible] withering Jan. 15, 18 leaves, shoots 4.2 + 3.5 cm, first and second axils respectively.

K 2

M 4 — N_1 [illegible] Jan. [illegible], 17 leaves, branches 3.5 + 3.5 cm, first and second axils
P_5 withered Jan 17, 13 leaves, branch 5.0 cm, first axil

[illegible] wanting [illegible]

A 3

J_1

O_2 — Bud in 4th axil Jan 15, '[illegible]

[illegible] wanting [illegible]

[illegible]

I_2

Jan. 1[illegible], [illegible]9

Seedlings from B[illegible] seed, [illegible]

Transplanted

Culture	
43	79
44	44
45	12
46	24
47	55
49	55
50	32
51	56
52	4
53	48
54	4
55	82
56	82
57	4
58	4
59	4
60	4
61	4
62	4
64	40
65	43
72	163
73	6
74	6
75	6
75a	6
76	6
77	6
78	6
79	6
80	6
81	56
[illegible]	6
	1013

Jan. 14, 1909

Culture 74. One with tip withered

Culture 43. Additional plants with withered tips as follows:

A_3, 16 leaves, branches 0.5 and 6. cm, from cotyledons

D1, 13 leaves, branches 3. and 6. cm, cotyledonary

D3, 13 leaves, branches 5. cm, first axil.

I5, 17 leaves, branch 4. cm, third axil.

J5, 14 leaves, branches 4. + 4.5, cotyledonary

June 15, 1907.

Culture 74. There has been a slight amount of root growth in some, but not all the plants, but the growth is short, thicker than usual, and the surface cellular corrugated

Jan. 15, 1909

The Kalmia peat used in potting Cultures 43 to 53 was delivered at the Department June 12, 1908. Whether it was freshly gathered at that time is not known.

Jan. 14, 1909

Culture 43. Many of the Kentucky seedlings are showing the minute hairy first leaf, still much smaller than the cotyledons.

Jan. 16, 1909

Culture 91. Thirty plants from Culture 37 transplanted to half of a flat in a soil of pure [illegible] peat taken from the lower surface of the peat clods, ~~from~~ in the 30-barrel lot bought by the Department 1908. Rubbed through a quarter inch sieve. Soil rubbed from the roots with the finger

Culture 92. Twenty-five plants [illegible] as 91 except the soil, this made of the whole peat clod, after [illegible] and [illegible], chopped and [illegible] rubbed through a quarter inch sieve. Planted in same flat as 91

Culture 93. Twenty-five plants, same flat as 91 + 92, same soil as 92, but with 1 part by bulk of cow manure added to 20 parts of the peat. The cow manure was [illegible] [illegible], unleached manure, dried under cover and pulverized by rubbing through a fine screen.

Jan. 18, 1909.

Culture 43

Tips withered

A 2

A 3

A 4

B 3

C 1

C 4

D 1

D 3

D 4

D 5

E 1

E 2

E 3

E 5

G 3

G 5

H 1

H 2

H 4

I 4

J 4

J 5

K 2

L 5

M 4

M 5

N 1

P 5

B4 Tip broken or eaten long ago.

B1 withering Jan. 20, 16 leaves, shoots 4.3 + 5 cm, cotyledonary

B2 " " " 15 leaves, shoot 5 cm., cotyledonary

" " " 15, leaves, shoot 7 cm, cotyledonary

B5 " " " 16 leaves, shoot 1.5 cm, cotyledonary.

C2 withering Jan 20, 16 leaves, shoots 4 + 1.2 cm, cotyledonary and first axil respectively

C3 withered Jan. 19, 15 leaves,

F1 withering Jan. 19, 15 leaves, shoot 5.5 cm, first axil

F2 withered Jan. 20, 16 leaves, shoot 4.6 cm., first axil

F3 withered Jan. 19, 15 leaves, shoot 4.5 cm, first axil

I5 Withered Jan. 21, 18 leaves, shoot 6. cm., cotyledonary

K4 Withered Jan. 21, 19 leaves, shoots 3.2 + 3.6 cm, first and ~~third~~ axils respectively

L1 withered Jan. 20, 20 leaves, shoots 8 + 6. cm. first + third

N5 withering Jan. 19, 18 leaves, shoot 1.6 cm, second axil

Buds wanting

H 3

I 1

Branches vary

H 5

L 2 Jan. 20 branches 2 and 2 mm., 3rd + 4th axils

O 2

Jan. 15, 1907

Culture 90 Type classified as follows:

C_2
E_2
G_1
H_1
I_1
I_2
K_4
L_4

The plants in 90 are much less fertile than those of Culture 89. They have grown in a warmer house and perhaps have had less sunlight.

Jan. 18, 1909

Culture 89. Leaf rudiments withered as follows:

A_4
B_1
B_2
B_4
C_1
C_2
C_3
D_2
E_4
F_1
F_3
H_3
I_3
J_1
J_4
K_1
K_3
K_4
L_2

Jan 19, 1909

Culture 89. Plunged the pots in live sphagnum in the flat ~~[illegible]~~ yesterday. The twenty-two plants with withered tips placed at the label end of the flat.

Culture 90. Plunged in sphagnum like 89. Eight plants with withered tips and 2 with bad tips placed at the label end of the flat

Jan. 20, 1909.

Large bud formed last fall on the largest shoot of the largest plant in the aquarium. Bud 10 mm. long. Axil of basal bract containing a bud composed of bracts. Second axil the same. Third axil the same. Fourth axil empty. Fifth axil same as first to third. Sixth empty. Seventh axil containing a flower bud with an extra bractlet on the pedicel above the two regular ones. Eighth same as seventh, but the flower bud withered. Ninth same as eighth but without the third bractlet. Tenth same as ninth. Eleventh same. Twelfth same. Thirteenth same but flower not withered. Fourteenth same as thirteenth. Fifteenth same. Sixteenth same. Seventeenth same. Eighteenth same, flower bud withered. Nineteenth same, but flower not withered. Twentieth same, but flower withered. Twenty-first empty.

Cultures of 1907 seedlings. Twelve flowers open thus far, ten pollinated, one dropped without pollinating, one not yet pollinated.

Jan. 20, 1909.

Day before yesterday I examined two of the cultures made by Mr. Kellerman in October 1908, from the roots of seedling Vaccinium plants.

One, a pale brown fungus, showed necklaces of conidia-like cells ~~borne~~ on a small tree-like branched hypha arising from the agar. In the same culture were nearly black stellate structures (under a hand lens) which proved to ~~consist~~ of ~~a~~ strings ~~succession~~ of teleuto-spore-like dark colored bodies. Mrs. Patterson to-day sends me an identification of the contents of this tube as *Alternaria* (with the teleutospore-like bodies) and *Oospora* (with the necklace-like conidia).

The second culture was a white fungus covering the surface of the agar with its hyphae and bearing grape-like clusters of conidia-like bodies borne on club-shaped branches. This Mrs. Patterson calls questionably a *Sporotrichum*?

No one of these fungi is at all related to the pycnidia-bearing mycorhiza grown by Miss Ternetz as a *Phoma*.

UNITED STATES DEPARTMENT OF AGRICULTURE,
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OFFICE OF
TAXONOMIC INVESTIGATIONS.

Jan. 25, 1905

Culture 72. Top of one box sprinkled with a thumb pot full of pulverized sheep dung, to see if the harmful action of the raw peat can be corrected.

Culture 75A The plants of this culture are notably better than those of any of the cultures from 73 to 80. The small amount of manure applied to have corrected the deleterious tendency of the raw peat in 73, and to have avoided the killing of the roots by too much manure in 74.

Jan. 2, [illegible]

[illegible] 91, 92, 93, No tips [illegible] [illegible]
[illegible]

[illegible] 73 Tips all without
74 Two tips without
75 One " "
75A One " "
76 Four " "
77 " " "
78 " " "
79 " " "
80 Two " "

[illegible] 45 Jan 21, 1907

Tips not withered

A5 Proves to have lost its [illegible]

C5 Withered Jan. [illegible], 14 leaves, shoot 6.[illegible] cm. first [illegible]

D2 Withering Jan. 23, 1[illegible] leaves, [illegible] 6.[illegible] cm, first axil

E4

F4 Withered Jan. 2[illegible], 14 leaves, shoot 9 cm, first axil

F5 Withered March 5, 20 leaves, shoots 17.+16.5 cm, first + second axils

G1 Withered Feb. [illegible], 23 leaves, shoots 14.5 + 22, cot.

G2 Withered Jan. 28, 15 leaves, shoot [illegible] cm,

G4 Withered Feb. [illegible], 24 leaves, shoots 6.5 + 7.5 cm. first and second axils

H3 Withered Feb. [illegible], 1[illegible] leaves, shoot [illegible] cm,

H5 [illegible], [illegible] leaves, shoots 1.5 [illegible] + 1.3 cm, cot. + first

I1 " " " 22 leaves, shoots 2.3, 2.5, 3.7 cm, cot. [illegible] first

I2 Withering Feb. [illegible], 19 leaves, shoot 13. cm,

I3 [illegible] 16 leaves, shoots 6.4 + 3.5 cm, first +

J1 Withering [illegible], 20 leaves, shoots 3 + 4.5 cm, first and second axils

J2 Withered Feb. 12, 19 leaves, shoots 3.5 + 4.5 cotyledon and first axil

J3 Withered March 5, 22 leaves, shoot 15.3, cotyledonary

K1 Withered Feb. 22, 19 leaves, shoots .3, 5.8, + 12. cm, cot., first, + sec. axil

K3 " " " 21 leaves, shoot 7.5 cm, first axil.

K5 [illegible], 19 leaves, shoots 3.5 + [illegible] cm

L2 [illegible]

L3 [illegible] 7 cm, cotyledonary

L4 Withered Feb. 19, 18 leaves, shoot

M1 Withering Feb. [illegible], 22 leaves, shoot

M2 Withered Jan. 24, 13 leaves, shoots 3.2 [illegible] 4.0 cm, [illegible]

M3 Withered Feb. 25, 26 leaves, shoots 17 + 19.6 [illegible]

N2 Withered Jan. 23, 15 leaves, shoot 7.1 cm, first axil

N3 [illegible] shoots 3.5 + 16, cot. + 3rd axil

N4 Withered Feb. 22, 20 leaves, [illegible] 14 leaves, shoot 12 cm, cot.

O1 Withering Jan. 22, [illegible] leaves, shoots 1.5 + 3. cm, cot.

O2 Withered Feb. 22, 21 leaves, shoot 6.3 cm, first

O3 Withering Jan 23, 18 leaves, shoots 15. + 32. cm, first + third

O4 Withered Mar. 5, 18 leaves, shoots 11. cm. first axil

O5 Withered Feb. 25, 22 leaves, shoot [illegible] second

P1 [illegible] Feb. [illegible] 19 leaves, shoots 12. cm [illegible] + [illegible] cot. +

P2 Withered Feb. [illegible], 17 leaves, shoots 2.5 + 11. cm.

P3 [illegible], 18 leaves, shoot 5.8 cm

P4 Withering [illegible], shoot 12. cm

withering [illegible] 3, Feb. [illegible], 18, March 6, [illegible]

[illegible]

T3 [illegible]
T1 [illegible]

Communicating [illegible]

H3 [illegible]
U2

[illegible] H3 [illegible]

[illegible]

K5 [illegible]

U2 [illegible]

June 22, 1969

[illegible] 69. First leaf on some of the Kalmia [illegible] as large as [illegible] [illegible]

Jan 23, 19[illegible]

Culture 91. One tip withered, B_4

92. No tips withered

93. Three tips withered L_4, M_1, P_1

Jan 25 19[illegible]

Culture 91 Tips withered A_1 B_1 B_4 E_4 [illegible]

92 No tips withering

93 Tips withered L_3 [illegible]$_4$ M_1 [illegible] P_1

Jan 2[illegible] 19[illegible]

Culture 91 [illegible] F_1

Jan 2[illegible]

Culture [illegible] [illegible] withered A_5

93 [illegible] withering, but [illegible] not
[illegible] withering of the usual type, P_5

Jan. 28

Culture 92 Tip [illegible] withering, G_3

Jan. [illegible]

Culture 91 [illegible] withered E_2

Culture 92 Tips withered G_3

Abst. V, January 27, 1909

In an endeavor to secure mycorhiza-free plants upon which to try inoculation experiments with the pycnidia-fungi grown from the roots of Ericaceae and Vacciniaceae, seeds from various plants were superficially sterilized in 1% hydrochloric acid or 1% formalin, washed in sterilized water, and sown on slices of sterile peat in glass jars ([illegible]) with ground-glass covers. The peat had been twice sterilized, at an interval of one [illegible] [illegible], at a temperature of 120°C.

Seeds were used from _Calluna vulgaris_, _Andromeda polifolia_, _Oxycoccus oxycoccus_, _Vaccinium myrtillus_, _V. vitis-idaea_, and _V. virginianum_.

In most cases were mycorhiza-free [illegible] secured. The seeds of _Vaccinium_ and _Andromeda_ did not always [illegible]. Those of _Calluna_ germinated [illegible] in [illegible] days, and although [illegible], then [illegible] the seedlings at a height of 1 to 1.5 cm. [illegible], at 2.5 to 3 cm. no trace of a fungus [illegible] could be found [illegible] not a single plant [illegible] free from it.

over

Over

The sterilization of the seeds, especially in Cassuma was necessarily very imperfect on account of the adherent air

Ternetz 1907, 358.

United States Department of Agriculture,

OFFICE OF CHIEF CLERK.

WASHINGTON, D. C. ...., 1895.

MERCHANTS' DELIVERY CO.,
912 Pennsylvania Ave., N. W.,
Washington, D. C.

Gentlemen:

Please call at ....

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for ....

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and deliver the same at ....

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Very respectfully,

....
Chief Clerk.

Abstract. Jan. 22, 1908.

Pycnidia develop in the crude cultures only in the relatively few cases in which there is little contamination by bacteria and molds. In these cases the pycnidia appear in 5 to 16 days on the average.

Ternetz 1907, 360

The pycnidium fungi show their characters best in test tube cultures (Reagensglas-Schrägculturen)

Ternetz 1907, 361.

United States Department of Agriculture,

OFFICE OF CHIEF CLERK.

WASHINGTON, D. C., ______________, 1895.

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Very respectfully,

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Chief Clerk.

Abstract, January 22, 1909

The pycnidia-fungi were obtained as follows:

Pieces of young roots of Ericaceae and Vacciniaceae*, 2 to 4 mm. long, were washed in 1% hydrochloric acid and then in sterilized water. They were placed in petri dishes and moist chambers on a culture medium consisting usually of 2% agar with a decoction of peat or rhododendron leaves added.

In the moist chamber cultures a strong septate mycelium developed in 24 hours and after a couple of days took on a brownish color. The cultures were frequently contaminated, especially with _Penicillium glaucum_ and _Mortierella_ root [illegible]", sometimes preventing entirely the growth of the root fungus. Ternetz 1907, 356.

* _Calluna vulgaris_, _Andromeda polifolia_, _Erica carnea_, _E. tetralix_, _Vaccinium myrtillus_, _V. vitis-idaea_, _V. uliginosum_, and _Oxycoccus oxycoccus_.

United States Department of Agriculture,

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Very respectfully,

____

Chief Clerk.

Abstract, Jan. 22, 1909.

The pycnidia vary in size from a small pinhead (176 to 196 μ) in the root fungus of Oxycoccus to less than half that diameter (76 μ) in <u>Vaccinium myrtillus</u>.

The spores vary from 3.9 to 5 μ in length and 1.3 to 3 μ in thickness.

The plants were grown on a mixture of equal parts of a 2% agar solution and a decoction of the leaves of <u>Rhododendron ponticum</u>. The decoction was made with 50 grams of the fresh leaves boiling two hours in 1000 cc. of distilled water, filtering, and the filtrate concentrated (eingeengt) to 400 cc. and again filtered. When a decoction of peat instead of Rhododendron leaves was used the development of the fungi was extremely poor.

Ternetz 1907, 365 to 369.

United States Department of Agriculture,

OFFICE OF CHIEF CLERK.

WASHINGTON, D. C. ...., 1895.

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Very respectfully,

....

Chief Clerk.

Abstract Jan 23, 1909

In *Azotobacter chroococcum* the proportion of nitrogen to the dry weight is 10% to 12%, in the root fungus of *Andromeda polifolia* and *Oxycoccus oxycoccus* 17% and 18%, all grown in nitrogen-free solutions.

Ternetz 1907, 387

In *Clostridium pastorianum* grown in a nitrogen-free solution for each gram of dextrose consumed there was fixed 1.34 mg. of atmospheric nitrogen, in *Azotobacter chroococcum* 10.66 mg.; in *Pseudomonas radicicola* 11.6 mg.; and in the root fungus of *Oxycoccus oxycoccus* 18 mg.

Ternetz 1907, 389.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

Abstract Jan. 23, '09

The nitrogen-free culture solutions used to determine the capacity of the root fungi for absorbing atmospheric nitrogen were made up as follows:

	For most of the cultures	Variations
Dextrose	7%	2 to 20%
KH_2PO_4 (acid potassium phosphate)	0.5	.01 to 1
$MgSO_4$ (magnesium sulphate)	.01	.002 to .2
$CaCO_3$ (calcium carbonate)	.01	.01 to 4
$NaCl$ (salt)	Trace	Trace
$FeSO_4$ (ferrous sulphate)	Trace	Trace

Cane sugar (2%, 10%) or mannite (2%) were sometimes substituted for dextrose, and $MgCO_3$ for $CaCO_3$.

Ternetz, 1907, 356-367.

UNITED STATES DEPARTMENT OF AGRICULTURE,
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OFFICE OF
TAXONOMIC INVESTIGATIONS.

Jan. 23, 1909

Miss. Ternetz in accounting for the unusually small growth of one of her root fungus cultures said that the explanation was to be found in the slight bacterial contamination of the culture, and states that all the root fungi are very sensitive to such contamination.

This suggests the importance of sterilizing with peroxide of hydrogen the pieces of root used in starting cultures.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

OFFICE OF
TAXONOMIC INVESTIGATIONS.

Jan. 27, 1905

Culture 09 Many seedlings with the first leaf as long as the cotyledons [illegible] the retardation of the [illegible] [illegible] evident, one plant with the first leaf twice as long as the cotyledons.

Jan. 26, '09.

Culture 89. Four more plants with withered tips placed toward ~~near~~ the label end of the flat to-day, making 27 withered and 29 not.

Hypericum culture. Cut off at the base one of ~~the stem of one of~~ the branches that was layered four months ago. It is firmly rooted.

Culture 90 No more plants with withered tips.

Jan. 28, 1908.

A trap of *shaken* peat prepared today by Mr. Franks and placed under a bench in the greenhouse. Kept watered. This is expected to avoid the troubles of Cultures 55 & 56, et seq.

[illegible]

Culture 91 Tips withered A_1, A_3, B_1, B_4, E_2 [illegible]

F_1 E_3

Culture 92 Tips withered G_3

Culture 93 Tips withered L_2 [illegible] M_1 [illegible]

Jan [illegible]

In 91 D_1, F_2 withering

Feb [illegible]

No change

[illegible]

In 91 withered C_3

Feb. 4

No change

Feb 5

No change

[illegible]

No change

Feb 6

In 91, withered A_4

Feb. 9

In 91, withered B_3

Jan. 29, 1901.

Take a bunch of fresh kalmia peat containing its roots and prepare portions as follows:

1. Rub a portion of the fresh peat through a sieve, roots upper leaf layers and all.
2. Shake out a portion of the fresh peat, so that it contains no freshly killed roots.

Make drained places for planting with these soils and watch the effect of the two freshly killed roots.

3. Shake out a portion of the fresh peat from the under side of clods so as to have neither roots nor ~~fresh~~ upper layers of leaves.

Make a drained place for planting with this soil, the growth of the plants to be observed in comparison with those of no. 2, which contains more of the upper leaf layers.

4. Take out a set of clods and dry them until the roots are dead and dry. Then moisten

them and lay in a pile to decompose. ¶ At intervals of two weeks make drained glass pot plantings ~~of~~ this soil and ~~in~~ ~~pots~~ ~~portions of~~ the undried clods, both freshly prepared in the same manner as no 1.

5 Take a bushel of year-old well rotted kalmia peat.
Make checks plantings, in drained glass pots, to go with 1, 2, + 3 and another to go with each of the no. 4 plantings.

Jan 29, 1909.

Cultures 74, 75 + 75A. It is [illegible] that in these cultures, which have cost only [illegible] each, and in which [illegible] growing tips, the tips are growing well, the manure ([illegible] % respectively) has acted so as to offset to a conspicuous degree the injurious effect of the fresh peat exhibited in Culture 73. Fair root growth and good top growth is taking place in 75 and 75A. In culture 74 the amount of manure ([illegible] %) is so [illegible] as almost to inhibit root growth, roots showing in only two pots and these very scantily. The top growth in 74 is now very slow the plants averaging only 3.4 cm. in height as opposed to 5.3 cm. in 75 and 5.9 cm in 75A.

Cultures 78 and 79. The root growth is extensive, but the tops have made essentially no [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] color more [illegible] than 73 [illegible] as [illegible] 80, and [illegible] 64, 65, and [illegible]. Their average height is 78, 3.7 cm 79, 3.9 cm.

Jan. 29, 1909.

Culture 91. The plants of this culture are doing notably worse than those of Cultures 92 and 93. The tips have withered in 27% as opposed to 4% in 92 and 24% in 93. Stagnation of the ultimate leaf rudiment is more evident in 91 than in the others. The tendency to develop a dark purple color in the old leaves ~~is much more~~ ~~pronounced~~ is conspicuous in 91, not at all observable in 92 + 93. ~~[illegible]~~

In 91 the ~~soil~~ peat contains many broken ~~leaves~~ roots probably killed by rubbing the peat through a sieve. In 92 and 93, prepared in the same way ~~several~~ a few weeks ago these roots have presumably had time to decompose to a sufficient extent to render them innocuous.

The oak roots in the peat clods placed in the shed in November are still alive.

Jan 30, 1909

Culture 76. All but one of the plants have their life stimulated, and that one has its leaf rudiment dormant. In all the tendency to be purplish-leaved is pronounced. All have made a little new root growth. The average height of the plants is 4.1 cm.

Culture 77. Two plants still have [illegible] the [illegible] alive but stagnant. Root growth is very feeble. The old leaves [illegible] purplish. The average height is 3.7 cm.

Barrel of freshly gathered kalmia peat delivered this morning. Placed in chrysanthemum house. Portion of the clods laid out in the green-house to dry.

Feb. 2, 1909

Culture 54

No more tips withered. Plants now beginning to grow.

Cultures 55, 56. These plants have been growing well for the last two weeks past. The old leaves have lost their purple color.

Cultures 57 to 62, 64, 65. The plants are now putting forth new growth though many have the old leaves still purple.

Culture 72. The plants in open flats are growing, some of them however, with old leaves still purple.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb. 3, 1909.

Cultures 41, 42 etc. In none of the plants of the 1907 seeding, brought into the greenhouse about Dec. 1, after having shed their leaves and ripened their wood out doors, has any good new growth taken place. Twelve plants have flowered [illegible]. 50 with flower-buds, and the flower [illegible] buds of [illegible]. One hundred and one plants out of [illegible] seeding, those in glass pots, give [illegible] growth [illegible], their leaves [illegible] not even [illegible]. [illegible] only a very few of the plants [illegible] new [illegible] growth [illegible]. The wood and buds are [illegible] little [illegible] in good condition, [illegible] new branching [illegible] taken place. [illegible] been [illegible] growth [illegible] of 4 or 5 [illegible] the small [illegible] [illegible] flowering [illegible] shoots [illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb. 4, 1909.

Culture 69. Second leaf in many of the plants as large as the cotyledons.

Feb. 5, 1909

Culture 67. One cutting dead one with scanty top and root growth not repotted. Four plants repotted in 3 inch pots in Sand 1, loam 1, shaken peat 8. Remaining five plants made into

67A

Culture 67A Five plants of Culture 67 re-potted today in 3-inch pots in sand 1, loam 1, Bisset leaf mold 8.

All the nine plants in 67 that were re-potted had an abundant growth of roots at the wall of the thumb pots.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb. 5, 1909

Soil 1. Sphagnum peat. Nov. , 1908, peat taken from pile Jan. 1909, shaken out and kept since in a bag in the greenhouse.

Soil 2. Mold. This is rotten oak and maple leaves rotted 5 yrs by Mr. Brasel on Mrs. Hubbard's place.

Soil 3. Fresh peat, rubbed. Kalmia peat delivered Jan. 30, dried six days, then rubbed through a sieve, all the roots going through. Moreover

Soil 4. Nepenthes peat, chopped. Same as 1, but taken from pile chopped to day, so as to keep all the roots in. Some are still alive.

Soil 5. Same as 4, but rubbed through a quarter inch sieve, little of the roots going through.

Feb. , 1909

Soil 6. From culture 43, [illegible]

7. From Culture 57, [illegible]

8. From culture 74 [illegible] manure

9. " " 75, one fifth manure

10. " " 75A. one ninth manure

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BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

[illegible]

Culture 74. The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] any root [illegible] [illegible]

Culture 99. Sixteen plants from culture 34, transplanted [illegible] [illegible] 10 th, 2 [illegible] inches apart in a soil [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]) 8 [illegible] [illegible] 1 [illegible] [illegible] 1 [illegible].

Culture 100. Sixteen plants same as [illegible] 99, [illegible] [illegible] [illegible] [illegible]) 8 [illegible], [illegible] [illegible] 1 [illegible]. [illegible] [illegible] [illegible]

Culture 101. [illegible]

Culture 99 [illegible] [illegible] [illegible] plants, [illegible] the [illegible] [illegible] [illegible] [illegible] [illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

Feb. 6, 1909

Culture 94. Six plants from Culture 39, carefully taken up and the soil snapped off, the plants then potted in thumb pots in Soil 1 of Feb. 5.

Culture 95. Same as 94, but potted in Soil 2.

Culture 96. Same as 94, but in Soil 3

Culture 97. Same as 94, but in Soil 4

Culture 98. Same as 94, but in Soil 5.

Feb. [illegible]

[illegible] [illegible] Tree [illegible]
with [illegible] is E_{3}, and [illegible]
was [illegible] been [illegible]
[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Feb [illegible]

In [illegible], C_1 D_2 D_3

In 99 [illegible] E_4 G_1 G_2 ([illegible]
[illegible]

In 101 J_4 K_3

[illegible] A_3 D_1

In 100 [illegible] E_1

In 101 [illegible] K_2 [illegible] M_3

Feb. 8, 1909

The dried fresh peat laid out about two weeks ago was separated into two portions yesterday. The first portion was rubbed through a quarter inch sieve. The lumps were not yet quite air dry, and some of the roots were not pulverizing. These were laid aside for further drying. The part that was rubbed through the sieve was also spread out to dry.

Feb. 9

The sieved part was wet today and placed in a 12-inch pot to decompose.

The dried roots were pulverized through a quarter inch sieve, ~~and~~ put in a 4-inch pot wet with water and left to decompose.

The remainder of the dried peat [illegible] was moistened and put [illegible] to decompose

Feb. [illegible]

Culture 91 Tips withered A_1 A_4 A_5 B_1 B_3 B_4 C_3 D_1 E_2 E_4 E_5 F_1 F_2

Culture 92 Tips withered G_3

Culture 93 Tips withered L_3 L_4 M_1 O_5 P_1 P_5

Feb. [illegible]

No change [illegible] [illegible]. [illegible] [illegible], all the tips not [illegible] [illegible] [illegible] [illegible] perhaps A 2 and B_5. In 92 and 93 the [illegible] [illegible] [illegible]

Feb. [illegible]

In 92, tips [illegible] [illegible] G_5

Feb. [illegible]

[illegible]

Feb. [illegible]

In 91, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] growing in A_2 B_5 C_5 D_5 [illegible] F_5 [illegible] [illegible] [illegible]

In 93, [illegible]

Feb. [illegible]

[illegible]

Feb. ? [illegible]

[illegible] 73. The alfalfa [illegible] of this [illegible] were [illegible] the roots being carefully taken from the soil

Culture 102. Cuttings of [illegible] were [illegible] from the Brooks [illegible] from Ridge [illegible] [illegible] [illegible] [illegible] of them were [illegible] to Mr. Hayes, to try [illegible] [illegible] [illegible] [illegible] [illegible] by [illegible]

There seems [illegible] [illegible] [illegible] [illegible] the [illegible]

[illegible]

Pha[illegible] [illegible]

Cultur[illegible]

37 [illegible]

44–45.

55. [illegible]

[illegible]

76 (one [illegible] and 77 ([illegible]) and 79 (burying in sand).

7[illegible] [illegible]

73 Ro[illegible]

7[illegible] [illegible]

[illegible]

[illegible]

67A

[illegible]

[illegible]

69

67

Feb. [illegible]

The [illegible] branch cut off from [illegible] aquarium plant a few days ago is not doing well. The [illegible] half off a day or two after the branch was [illegible] are blotched [illegible]

[illegible].

Culture 37   Feb. 10, 1909

About January 4, the remaining 19 cuttings ~~of Cotton~~ ~~[illegible]~~ were taken up and ten of them which had rooted were potted in ~~[illegible]~~ sphagnum peat and placed under a bell jar. These were removed from the bell jar yesterday. To-day they were given the number 103. The remaining ~~cuttings~~ cuttings without roots in January were put back in the sand under a bell jar.

To-day the remaining cuttings, 8 instead of nine, that were not yet rooted in early January, were taken up and the three rooted ones (one with a large callus, 13 mm. in diameter) were potted in peat & sphagnum, [illegible] numbered 104, and put back again in bell jar. The remaining 5 were put back in the sand again under a bell glass.

[illegible]

Unit of [illegible] Brazil[illegible]

is number of cubic centimeters of one-tenth normal solution required

to neutralize 10 grains of [illegible]

[illegible]. This is the [illegible]

[illegible] 100 pounds of [illegible]

[illegible] of ordinary [illegible]

Feb. [illegible]

Cultures 55, 56. Growing rapidly now, many of the new shoots 5 to 7.5 cm. long.

[illegible] Feb. [illegible]

Soil 11. From 76, [illegible]

12. From [illegible] 53, [illegible] [illegible]

[illegible], [illegible]

13. From 77, [illegible]

Feb. 14, [illegible]

14. Same as 3, but rubbed out on Feb. 9, and [illegible] moist, used in [illegible] 106.

15. [illegible] [illegible] the [illegible] [illegible] of the peat on Feb. 9, [illegible]

Feb. 23

16. Peat. From [illegible], shaken [illegible]. Used for [illegible] 44, 45.

[illegible]

17. Peat. Same as 14, but [illegible]

18. Peat. Same as 17, [illegible] [illegible] [illegible] [illegible]

19. [illegible] roots. [illegible]

Feb. – [illegible]

[illegible] 9 [illegible]

Owing [illegible] 96 [illegible].

(P[illegible] [illegible] with [illegible]

[illegible]

[illegible] 4, 50. [illegible]

[illegible]

[illegible] and [illegible]

[illegible]

F[illegible]

[illegible]

Feb. 17

95 Three witnessed

96 Two "

97 Three "

Feb. [illegible]

Culture 44. Three tips withered on second shoots

Culture [illegible]

Culture 47. Two tips withered

In [illegible] the branch is [illegible] many [illegible], [illegible] among more [illegible]. The [illegible] growing branches [illegible]

[illegible]

Culture 67, 67A [illegible] same [illegible] (be ringed) [illegible] only three [illegible] with.

Soil 20. Soil from a rose [illegible] plant of Culture 41 which has [illegible] remained, the plant was [illegible] since, before October 1st, in the [illegible]

Soil 21. A part of the [illegible] [illegible] from the same pot.

Soil 22. Cow manure brought in the greenhouse from the manure [illegible], first used in Culture 74, [illegible] [illegible], [illegible] not [illegible] dried.

Soil 23. Cow manure from the pile in the shed, [illegible] [illegible] as 22.

Soil 24. From the top of the barrel of [illegible] rubbed out by [illegible] a few weeks ago.

Soil 25. From half [illegible] in the same barrel as 24.

Feb [illegible] 17

[illegible] winter. Flower [illegible] of Cactus 23 [illegible] yesterday. Buds, probably [illegible] of Cactus [illegible] often several [illegible]

The plant numbered 23 was brought inside Feb. 17.

[illegible] 197. Feb. 5 [illegible] 197

Kalmia plants from [illegible] 67, having the third leaf from the cotyledons, [illegible] [illegible] [illegible] potted in [illegible] [illegible] a soil as follows (mixed [illegible].)

Kalmia peat, [illegible]	6 parts
[illegible] ( )	2 "
Sand	1 "
Loam	1 "

[illegible] by [illegible] Bryner

Feb. [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] 8, [illegible] 1, [illegible].

[illegible] 107. [illegible] as 106 [illegible] [illegible] [illegible] [illegible], sand 1 [illegible].

Planted in a [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]:

A, B_1, A_3, E_1, E_2, B_3, B_5, H_1, H_4 & K_1. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

Feb. 16. 93.

Culture 99. Tips [illegible] $A_1 A_3 B_4 C_1 D_1 D_2 D_3$

100 " " $E_1 E_3 E_4 G_1 G_2$ (H, [illegible])

101 " " $J_4 K_2 K_3 L_1 L_2 L_3 M_3$

Feb. 17.

Culture 99 Tips [illegible] $B_2 B_3$

Culture 101 " K_4

Feb. [illegible]

Culture [illegible] tips [illegible]

" 101 " " L_3 [illegible] M_2

Feb. [illegible]

Culture 101 Tips [illegible] J_2

[illegible] 99 [illegible]

the [illegible] in 101 [illegible]

[illegible]

more [illegible]

Feb. 16, 1899

Culture 91 Tips wilted A_1 A_4 A_5 B_1 B_3 B_4 C_3 D_1 C_2
E_4 E_5 F_1 F_2

Culture 92 Tips wilted G_3 I_5

Culture 93 Tips wilted L_3 L_4 M_1 O_3 P_1 P_5

Feb. 17

In 91 tips still wilted but disappeared in
B_2 C_1 D_2 D_4 E_3. E_1 is growing.
In 91, wilted tips D_3

Feb. [illegible]

[illegible] D_5

Feb. 22.

[illegible] distinct lessening of the purple color in the old leaves, the plants that are [illegible] most purple showing the least growth.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Calcium Mr. J. F. Brazeale. Feb. 16, 1909

Calcium, in order to neutralize acids must ordinarily be in the form of

Calcium oxide CaO
" hydrate $Ca(OH)_2$
" carbonate $CaCO_3$

Calcium in the following forms will not neutralize acids

Calcium sulphate $CaSO_4$
" chloride $CaCl_2$
" nitrate $Ca(NO_3)_2$

Mr. Brazeale says that he found that Soils 8, 9, + 11 (the only ones he tried) contained an appreciable amount of water-soluble calcium, more so than ordinary soils.

Feb [illegible]

Culture 69. Kalmia. Glass taken off [illegible] sphagnum under the glass was growing so luxuriantly as to [illegible] seedlings. The [illegible] plants are [illegible] part [illegible] covered by glass [illegible] without a layer of [illegible] fed sphagnum.

Culture 43. The plants are [illegible] [illegible] in [illegible] pots in [illegible] peat ([illegible]) 8, sand [illegible]. The plants are [illegible] from [illegible] the soil into [illegible] [illegible] [illegible] transferring [illegible] [illegible] [illegible] [illegible]. The [illegible] I [illegible] myself yesterday.

Culture 78. [illegible] plants [illegible] [illegible] with a [illegible] solution [illegible] Mr. Robinson, marked "[illegible] nutrient, re-action acid."

Culture 79. Same [illegible] 78. but [illegible] Normal [illegible], reaction [illegible].

Feb. [illegible] 1907

Culture 108. [illegible]

[illegible]

[illegible]

[illegible]

Pollen fert [illegible]

[illegible]

[illegible]

[illegible] 4 [illegible]
Potted by [illegible] Feb. [illegible]

Culture [illegible] Same as [illegible]

[illegible] 5, [illegible] 3, [illegible]

1, [illegible] Potted by [illegible]

Culture [illegible] 7, [illegible]

[illegible]

[illegible] any [illegible]

[illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb. 19, 1909

Culture 110. Twenty-five plants, same as Culture 108, but soil consisting of peat 3, mold 5, sand 1, loam 1. Potted by Miss Byrnes

Culture 110A. Twenty-five plants, same as Culture 108, but soil consisting of peat 2 1/4, mold 3 3/4, sand 3, loam 1. This is essentially the same mixture as 110, but with three times as much sand. Potted by Miss Byrnes

Feb. 20, 1901

Culture 111 Twenty five plants, same as Culture 108, but soil consisting of mold 8, sand 1, loam 1. No peat.

Culture ~~[illegible]~~ 111A Twenty five plants, same as Culture 108, but soil consisting of mold 6, sand 3, loam 1, essentially the same soil as Culture 111, but with three times as much sand.

[illegible] still forcing.
Of 17 plants in the greenhouse during the winter, 12 to-day have some of their buds swelling.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY.

EXPERIMENTAL GARDENS AND GROUNDS.

Washington, D. C.,

Feb [illegible]

Culture 78. The [illegible] photos [illegible] [illegible]

[illegible] on Feb. 17 showed a distinct

greenish surface (the same on Feb. 20,

the [illegible] but [illegible] any

such odor. The odor is [illegible]

[illegible] are [illegible]

Feb. 23, 1909

Culture 41A. A plant of 41 that had made sturdy growth and formed flowering buds during the summer, but since October at least has remained stagnant, though holding its leaves, in the rose house all winter. It has made no growth during the winter. To-day, it was removed from the pot, some of the bottom soil (containing to muck loam and sand) taken out to be tested as Soil 20, and part of the top mulch of kalmia peat taken out as Soil 21. The remaining ball was then repotted in a 5 inch pot in peat 6, sandy loam 1, and the plant returned to the rose house.

Feb. 2[illegible], 190[illegible].

Culture 34. Cuttings removed from the 5 inch pot to-day. It had been kept under a bell jar. All were dead except two, these growing well with extensive roots. These were potted in 4 inch pots in peat 6, sand 1, loam 1.

Culture 35. Five cuttings in sand in their original glass pot under a bell jar. All five were alive, and all but one rooted. Their roots were short, much branched, and very [illegible]. These were ~~potted~~ potted in 3 inch pots in peat 6, sand 1, loam 1, with a [illegible] of peat screenings in the bottom. One was reserved for root examination.

Culture 58. Two cuttings [illegible] alive, [illegible] growing. [illegible] potted in 3 inch pots in peat [illegible] loam 1, with a bottom of peat screenings.

Culture [illegible]. Of the cuttings [illegible] and [illegible] in sand on [illegible] 2, 1908, two [illegible] [illegible]; of these 3 one [illegible] one [illegible] rooted, one with [illegible].

Feb. 25, 1909

Culture 44 ~~45~~ Forty plants repotted on Feb. 20 in 4 inch pots in peat 8, sand 1, loam 1.

Culture 45. Eleven plants. Same treatment as 45.

Culture 46. Twenty-three plants. Same treatment as 44.

Culture 50. Thirty-two plants. Potted Feb. 2~~3 in~~4 & 25 4 inch pots, in peat 8, sand 1, loam 1

Culture 47 Fifty-three plants. Same treatment as 50

Culture 48. Fifty five plants. Same treatment as 50.

Culture 51. Fifty-two plants. Potted Feb. 24 & 25 in 4 inch pots in peat 8 sand 1 loam 1.

Culture 52 Four plants. Potted Feb. 25 in 4 inch pots in peat 8 sand 1 loam 1

Culture 53 Forty-seven plants. Same treatment as 52

Bench space

South end 1 ft 10 ½ in x 2 ft 6 in.
1 ft 1 ½ x 2 ft 5 in.

West side 13 ft. 7 in x 2 ft. 9 in
1 ft. 3 in x 2 ft 3 in

East side 24 ft. 1 in x 2 ft 9½ in.
1 ft 3 in. x 2 ft. 6 in.

Feb. 25, 1908

Culture 35. The rooted cutting reserved for examination, has roots of the staghorn type, 1 cm. or less long, ~~and which~~ breaking out of the bark above the callus. no mycorhiza are observed on it. The roots are ~~brown~~ mostly stout and somewhat opaque, but in the occasional clear portions the cell contents are plainly observable. Specimens pressed.

Culture 68. The rooted cutting reserved for examination has vigorous, beautifully transparent branched roots, mostly with 5 superficial rows of long epidermal cells, reaching a a length of two inches. No mycorhiza cells are observed after a careful examination. Neither of these three cuttings has made any stem growth. Specimen pressed.

Recent cutting. This shows no mycorhiza.
Specimen pressed.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

OFFICE OF THE BOTANIST.

12

Feb. 25, 1897

Culture 54 Four plants, same treatment as 52

Feb. 26, 1897

Culture 56. Eighty plants, [illegible] Feb 25 + 26, in pot 8, sand & loam

Feb 26, 1897.

Culture 102. The five cuttings, left under a bell glass at first, started to push new [illegible] forming [illegible] [illegible] [illegible] [illegible] [illegible]. The bell glass was taken off. To-day [illegible] [illegible] cuttings [illegible] [illegible] [illegible] [illegible] both [illegible] a [illegible] [illegible] [illegible] the other [illegible] [illegible] [illegible] [illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

OFFICE OF THE BOTANIST.

Feb. 25, 1909.

Culture 113. This number is given to the plant of Culture 25, that was brought up in the greenhouse several days ago, and photographed.

The last flower on the two buds that have opened thus far was pollinated to-day.

Culture 114. This number is given to the plant of Culture 23 that started to grow on the window sill and was brought inside Feb. 17 ~~a few days ago~~.

Culture 115. This number is given to a plant of Culture [illegible] from the window sill that started its buds on Feb. 15 and was brought in yesterday and placed in the greenhouse to-day.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

OFFICE OF THE BOTANIST.

Mr. Brazeale Feb. 26, 1909.

Potash

Potassium sulphate, K_2SO_4,

" chloride KCl

Kainit (a mixture of pot. chlor., mag. chlor. etc.)

When potassium sulphate ~~is~~ used as a fertilizer, the potash is ordinarily taken up, leaving the sulphuric acid which renders the soil acid unless lime is used. Similar action would follow from the other ~~plants~~.

Mr. Bragdale Feb. 27 '0[illegible]

Humus, according to the official method, is that portion of organic matter soluble in 4% ammonia. This method, however, removes the water soluble organic matter before the ammonia solution is effected.

[illegible] 26. [illegible]

Soil 27. Clay loam, [illegible] mixture.

Soil 28. Soil from [illegible] pot [illegible] plant of Culture #1.

Soil 29. Soil from growing plant Culture #2.

Soil [illegible]. Pure [illegible]. Same as [illegible] but [illegible] manure [illegible].

Soil [illegible]. Peat. Same as [illegible] but [illegible].

Soil [illegible]. Peat mixture. From a plant Culture 17, which was repotted in early December in [illegible] a [illegible] mixture. The plant was [illegible] flowering and made a slight leaf growth as well as some root growth, but the new root growth has not [illegible] as strong nor is the large growing healthy.

[illegible]

March [illegible], 1907.

Soil 34. Peat mixture. ~~[illegible]~~ The soil in which ~~the~~ thumb-pots containing the plants of Culture 44 were plunged when they were potted in November, 1906.

Soil 35. Soil from bottom of Culture 113 (a special plant of Culture 25), pure ~~[illegible]~~ peat in the pot since Culture 25 was potted.

Soil 36. Soil from bottom of Culture 114 (a special plant of Culture 23, sand, the surface mulched with peat.

Soil 37 Soil from bottom of Culture 115 (a special plant of Culture 17, which was a good blueberry mixture)

over >

March [illegible]

Soil 53 From a pot of Culture 74, the manured peat that finally killed ~~the~~ its blueberry plants. (Bacterial sample No. 6)

March 12, 1907

Peat water from barrel at [illegible]

March [illegible] Water filtered

Soil 55. From the aquarium culture

56. From culture 105

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March 9, 19[illegible]

S[illegible] from [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] as follows

			[illegible]
Soil 38	Cult[illegible]	[illegible]	.[illegible]
39	"	1	[illegible]
40	"	[illegible]	.4
41	"	2	Alkaline
42	"	13	.1
43	"	[illegible]	.2
44	"	15	.2
45	"	1[illegible]	.2
46	"	18	1.1
47	"	[illegible]	.3
48	"	2[illegible]	Alkaline
49	"	2[illegible]	.1
50	"	22	Alkaline
51	"	23	Alkaline
52	"	27	Alkaline

March 2, 1907

Culture 113. Plant potted yesterday in an untrimmed [illegible] liter beaker, 3 cm. of coarse [illegible] at the bottom, next 3 cm. of peat roots. Then the ball of earth from the old pot ~~was put in~~ set up and pressed against the side of the vase, and the remaining [illegible] filled with a mixture of peat 5, sand 1, loam 1 and a layer of (peat 2, sand 1, no loam) and peat moss [illegible] in [illegible]

Culture 114. Treated same as culture 113.

Culture 115. Potted same as culture 113. [illegible] in the greenhouse.

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March 2, 1909

Transpiration of Vaccinium corymbosum

Began a transpiration measurement experiment with a plant of Culture 75A. The plant is in a 5 oz whiskey glass with a small hole in the bottom. The hole was plugged by rubbing into it a mixture of paraffin (45° melting point) 75%, vaseline 25%. Then the surface of the soil was sealed by pouring over it a layer of the same mixture melted and cooled almost to the temperature of solidification. The mixture solidified almost immediately after pouring and formed an apparently perfect seal of the surface, without injury to the plant.

The main stalk of the plant has a winter [illegible] is 10.4 cm high, with 19 leaves above the paraffin, the uppermost not fully grown; the lateral branch is 7.5 cm. high, with 10 leaves above the paraffin, the uppermost one conduplicate. The lowest leaf of the main stalk is 1.5 by 2 mm., the largest 13 by 20 mm., the others grading rather uniformly between; on the branch the variation is from 1.5 by 2 mm. to 12 by 16 mm.

The weight of the pot at 3:30 P.M. was 171.35 grams.
March 3 3:30 P.M. cloudy 170.86 "
[March 4 cloudy]
5 3:20 P.M. sunny 168.35 "
Glass broken, area measured, 8603 sq. mm.; one surface.

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May 2, 1901

Culture 120. Plant in experiment grafted to-day, in the frames, with scions from the Brook bush ~~[illegible]~~ removed Jan. 9, 1901 and since kept in moist sphagnum in a cold frame. The grafting was done by Mr. Gouger, two on branches of [illegible] wood, the [illegible] of which have [illegible] grown, the other on a stolon that has partially hardened wood. The grafting was done with a 3/4 inch diagonal cut, the two parts closely wrapped ~~to~~ together with raffia. Live sphagnum was then piled about the base of the plant and among the grafts, till only the [illegible] bud [illegible] of each scion was exposed to the air. The cut ends of the three scions were sealed with grafting wax.

Culture 121. A plant of 42 from the [illegible] bed grafted like 120, except that

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March 5, 1909.

Transpiration

Branch

Basal leaf	2 mm.	
Second "	7 "	
Third "	21 "	
Fourth "	46 "	
Fifth "	67 "	
Sixth "	112 "	
Seventh "	158 "	
Eighth	196 "	
Ninth	106 "	
Tenth	44 "	
		759

Main stem

Basal leaf	4 mm.	
Second "	6 "	
Third "	7 "	
Fourth "	8 "	
Fifth "	9 "	
Sixth "	24 "	
Seventh "	34 "	
Eighth "	35 "	
Ninth "	32 "	
Tenth "	32 "	
Eleventh "	39 "	
Twelfth "	51 "	
Thirteenth "	90 "	
Fourteenth "	102 "	
Fifteenth "	132 "	
Sixteenth "	171 "	
Seventh "	177 "	
Eighteenth "	91	1044
		8603 sq. mm.

March 5 1899

Culture 114. Pollinated 4 flowers on this plant to-day, using each flower's own pollen on its own stigma.

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[illegible] 5, 18[illegible]

October 22 This berry ripened in the greenhouse, one a dozen of this number, fully colored to-day, first [illegible] bloom on a dark purple ground. Diameter 10mm.
±

March 8, 1909.

Culture 43. The leaf ~~for~~ blades on some, the first apillary [illegible] are up to 5.8 cm. in length and 3.5 cm. in width.

Culture 41 Two plants in 5-inch pots from the rose house, stagnant since last summer, brought into the chrysanthemum house to-day

Culture 41 A One pot, brought from the rose house into the chrysanthemum house to-day, stagnant since last summer.

Culture 42 One pot, brought from the rose house into the chrysanthemum house to-day, stagnant since last summer.

Cultures 103, 104, brought into the rose house from the propagating house to-day, all in thumb pots, 104 3 plants, 103 10 plants.

March 9, 1909

Culture 115. No roots started as yet.

B P I

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March 8, 1909

Litmus tests of cultures in the original undrained glass pots potted on May 8, 1908, were started March 6, and came out as follows:

Culture 9. Slightly acid
14. Distinctly acid
17 Neutral
18 Distinctly acid.
19 Distinctly acid (blue at the ends)
20 Distinctly alkaline
21 Slightly acid
22 Distinctly acid
23 Alkaline
27 Neutral

Culture 12, tested today is distinctly alkaline.

March 12.

Culture 5 Distinctly acid.
13 Slightly acid
11 Distinctly acid
15 Faintly acid

BPI

9	55
51	52
52	4
53	4
54	4

56	50
112	50
40	40

10
5

55
25

200
25
125
350

200
125
100
425

112	1
40	1
114	25

Feb. 27 114 In peat 8, sand 1, loam 1 ~~In 44 plunging soil~~

~~115 In 45 & 50 " "~~

~~with 1/10 sand and 1/5~~

~~loam added~~

Mar. 18 115 ...

Mar. 1 116 ~~In 49 plunging soil~~

Mar. 9. 117 ~~In 51 plunging soil~~

~~with 1/10 sand & 1/5~~

~~loam added~~

Mar. 4. 118 ~~In 47 plunging soil~~

119 In 44 plunging soil

Ten plants in peat 8, sand 1, loam 1, with 1% hardwood ashes added (4.25 gr. per liter)

Ten plants in

~~lime~~ 1/10 % (.325 gr. per liter)

122. ~~Fifty~~

(loam 1, sand 1,) potted

123 ~~Fifty~~ Twenty-five plants of Culture 39, in peat 8, sand 1, loam 1, potted ~~in~~

27 Twenty-five potted

125 Fifty plants, from 39, in 3-inch pots in peat 7, manure 1, sand 1 ... potted ...

Mar 9. 126. ~~In~~ Twenty-five plants in 3-inch pots in peat 8, manure 1, sand 1

Mar. 9. 127 Twenty-five plants in 3-inch pots in peat 8, manure 1, sand 1, with bottom meal added ... of 350 gr.

Mar. 10. 128 Twenty-five plants in 3-inch pots in peat 8, manure 1, sand 1 with .04 % sulphate of potash (.14 gr. per liter) added ~~(3.5 gr. per liter of manure)~~

Mar. 10 129 Twenty-five plants in 3-inch pots in peat 8, manure 1, sand 1, with .1% bone meal and .04% sulphate of potash added. (.35 gr. bone meal per liter)

Mar. 19, 1918.

Culture 130. Six plants of Cutting #8, in 4 inch pots, set aside and watered with lime water (1.25 gm. calcium carbonate per liter). These plants are of the following heights

9 cm.
11 "
13 "
12 "
11 "
13.5 "

3 cm. in the [illegible]

[illegible] [illegible] of the [illegible], all being in lime ~~[illegible]~~ up to about 1%

Culture 41. Two plants, one in the [illegible]-nium, one from the rose house lot (brought to the [illegible] [illegible] a few days ago) watered with 150 cc. of 1/20 normal citric acid solution per each 5-in. pot. Plants [illegible] [illegible]

March 11, 1909.

Pollination.

On a few bushes berries that were not pollinated by hand are holding on, and growing. These differ from the hand pollinated berries by the fact that the upper surface of the ovary, within the calyx, is conspicuously convex, while in the hand pollinated berries this ~~growth~~ surface is concave.

Culture 37. The remaining 4 cuttings of that number were discarded to-day. One was dead throughout, one dead below, and two were alive throughout, though none bore leaves.

BPI

March 12, 1908.

Culture 130.

Watered to-day with 50 cc. limewater, each.

March 13, "

" " " " " 2nd " " March 13, '09

Window sill plants. The buds have now started on 12 out of fifteen plants as follows

2 a
6
15
18
22
24 (much-rooted plant)
25
29 a
29 b
30 b
31
41

Those not started are

2 b
17
24 (non-rooted plant)

In none of these (except possibly in 2a, 26, & 41, which are in stone, not glass, pots) ~~is~~ there any evidence whatever of root growth.

Cultures 113, ~~114, 115~~ No root growth yet. Flowering completed, first green growth with the long ago withering, new buds on the old wood starting to grow.

March 12, 1909.

Culture 120, 121. All four grafts in good condition, the wood fresh and plump and one or more buds pushing on each graft.

[illegible]

Culture 131. Acidity tests of soils as follows: Five inch pots

131 A Pure peat, light

131 B Pure peat, hard

131 C Peat 8, sand 1, loam 1, light.

131 D Peat 8, sand 1, loam 1, hard

131 E Peat 9, sand 1, light

131 F Peat 9, sand 1, hard

131 G Peat 8, manure 1, sand 1, light

131 H. Peat 8, manure 1, sand 1, hard

131 I Peat 4, sand 3, loam 3, light

131 J Peat 5, sand 5, light

Samples are to be taken at intervals of a month and tested for acidity, to ascertain the relative efficiency of these soils to maintain acidity.

Not used

March 13, '09

Culture 127. In every pot of this number a mold occurs in quantity. It is now in bunches, associated with the particles of bone meal. Many of the bunches have already fruited.

Culture 114. Almost every plant shows some degree of puckling [illegible] leaves, and 21 out of 25 plants have withered their tips.

Culture 115, which differs from 114 in having one tenth manure, has leaves much less conspicuously puckled, many of them not at all. ~~and~~ Unfortunately this lot of plants was badly selected, as ~~15~~ 20 out of 25 have been affected by the mite that [illegible] the leaves; in 114 none of the plants had the mite. In ten of 25 [illegible] the tips are not withered.

Ripe berries. Two more berries, making [illegible] [illegible] in the [illegible]. [illegible] of 11. All are of the [illegible] mm. [illegible].

Culture 120. Principal bud on each plant [illegible] 5.5 to 7.5 mm long!

March 13, 1909

[illegible] 15. Two plants from the bog in the greenhouse watered to-day for the first time, with peat water from the pond. Plants marked "peat water." No one of the four plants has started a bud though the wood is in apparently sound condition.

Began to-day to water with peat water

Culture 24. the two plants from the bog in the greenhouse lot. Both show a small new growing but the leaves are pallid.

Mar. 14, 1909.

Culture 78. The five plants that were watered on Feb. 17, Feb. 25, and Mar. 6 with an acid nutrient solution now show distinct signs of growth. The two plants that never [illegible] their tips are putting out new leaves of increased size. Of the other three plants one is putting out a new basal shoot, while in the two others the bud in the uppermost axil is pushing. In the check plant the buds are stagnant.

Ma[illegible] 13, 1909

Culture 132. Test of the acidulation of neutral soils. Five inch pots as follows

132 A ~~[illegible]~~ Leaf mould

132 B Loam.

Water with [illegible] water, ~~measuring~~ testing the acidity before ~~and~~ watering and as the watering goes on.

Mar [illegible], [illegible]

Culture 79. Of the [illegible] plants [illegible] with a [illegible] alkaline nutrient [illegible]tion on Feb. [illegible], Feb [illegible] and March [illegible], one is [illegible] or nearly so (it was in [illegible] [illegible] [illegible]), the [illegible] [illegible] stem [illegible] never withered [illegible] [illegible] leaves at the top, and [illegible] [illegible] [illegible] dormant buds as [illegible] [illegible] [illegible].

Culture 91. Good growth [illegible] [illegible] [illegible] all [illegible] [illegible] cultures, and the [illegible] of the old leaves was [illegible] in [illegible] first two [illegible] plants.

Cultures 92 + 93. Good growth [illegible] continued in both cultures, 93 [illegible] a little better than 92, and [illegible] being far superior to 91

Cultures 64 + 65. The [illegible] of [illegible] [illegible] larger than those [illegible] [illegible].

Culture 67. The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

Culture 67 [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] R. Roo[illegible] [illegible] but [illegible] [illegible] 67A [illegible] [illegible] [illegible] in 67.

March 15, 1909

Spores

On March 11 while examining the roots of a plant of Culture 76 for mycorhiza, the large spores first observed in a plant of Culture 5 on May 5, 1908 (see also May 16, 1908, in a plant of Culture 4), were found in abundance. Roots of the same plant examined March 13 and to-day were also found to contain an abundance of these spores. The roots were abundantly supplied with mycorhiza also, gorged with mycorhiza. The spores occupied, like the mycorhiza, the epidermal cells only, usually a single one in a cell, occasionally two. Although hundreds of spore cells were examined none (except in one doubtful case) contained any evidence of a mycorhiza knot.

Most of the spores were of the pitted, knob-le-shaped type described in 1908, with granular contents, the sides of the optical section having 6 7 8 or 9 sides in all

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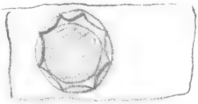
Mar. 15, 1909

Spores (con; 2)
the cases counted

b 

In a few cells were found spores of a little smaller size with only a single membrane and the contents granular. These are probably a younger stage of the spores.  a

Apparently intermediate stages occurred.

In a very few cases the granular contents of the spore was somewhat contracted, the double surface covering thicker than usual and the pit markings almost obsolete  c

This appears to be a stage in the development of the spore prior to that next to be described.

A few cells contained spherical bodies, apparently spores,

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Mar. 15, 1909.

Spores (con., 3)

which had a single-membraned thin cell, and hyaline interior, as if the contraction of the granular content as shown in figures c had been completed and the fat markings had disappeared entirely.

 d

In one case one of these hyaline spores had developed a distinct but short hypha

 e

The material examined to-day, on which most of the observations were based, was detached from the plant and washed on March 11, and kept since in water. One fragment has been in a moist cell since March 11.

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March 15, 1909

Culture 120. Adventitious buds on the Kalmia grafts 8 to 10 mm. long.

Culture 131. No new roots from the plant yet, though new ericaceous rootlets 2 to 3 mm. long have been thrown out from some of the ericaceous roots in the mass of coarse Kalmia peat in the bottom of the beaker. This peat was gathered in November, 1908. All the earlier ~~leaves~~ branches that developed since the plant was brought indoors, eighteen in number, have withered their tips. The longest of these has an axis of 17 mm. and [illegible] bracts and leaves. Other branches are beginning to grow, and additional [illegible]

Culture 66. ~~One of the~~ The two [illegible] plants in [illegible] drained glasses have made very large root systems. One has developed a branch of 103 mm. length. The other has developed only short branches (10 mm. [illegible] long), but has [illegible] flowering buds which are now pushing out the flower head [illegible].

March [illegible]

[illegible] 50 [illegible] with [illegible] each.

March [illegible]

Each 50 [illegible]

March 2[illegible]

Each 75 cc. lime water

March 23

Began [illegible] giving each [illegible] 50 cc.

March 24

Each 50 cc lime water.

March 26

Each 50 cc lime water. No [illegible] growth as yet. Plants growing vigorously.

March 27

Each [illegible] lime water

March 29

Each 50 cc lime water.

April 1

Each 50 cc lime water

April 2

Each 40 cc lime water.

April 3

Each 40 cc. lime water

Nov. 5 [illegible]

Each 50 [illegible]

Culture 30 April 7

Lime water 50 cc. each

April 8

Lime water 50 cc. each

Apr. 9

50 cc each

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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Cutler [illegible]

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Cutler [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Cutler [illegible]

[illegible]

[illegible]

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Culture 75 March 29, 1909

Examined the roots of a feeble plant of this culture. No resting spores no intracellular mycorhiza. On a few roots an external fungus, possibly a mycorhiza fungus.

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March [illegible]

Soil 57. Peat [illegible], granite [illegible]

Magnolia [illegible]

Soil 58. Peat [illegible], from the [illegible]

March [illegible]

Soil 59. [illegible], from the [illegible] [illegible] of the [illegible] [illegible]. [illegible] Loam [illegible] [illegible] March [illegible] was [illegible]

Soil 60. [illegible], from [illegible] [illegible] blueberry [illegible] from [illegible]

Soil 61. [illegible] in [illegible].

Soil 62. [illegible] [illegible]

Soil 63. Manure water, from the [illegible] [illegible] of the [illegible], used [illegible] &c.

April [illegible]

Soil 64. Soil from a [illegible] of [illegible] 1/2, sand [illegible] in soil [illegible] [illegible], [illegible] alkaline!

Soil 65. [illegible] from the [illegible] [illegible]

Titration 15 cc per 200 [illegible] ~~[illegible]~~ normal

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] Sand [illegible] [illegible] [illegible] normal

[illegible] [illegible] [illegible] [illegible]

April [illegible]

[illegible] [illegible] from the [illegible]

Soil [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] (or ~~[illegible]~~ normal)

Soil [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible]

April [illegible]

Soil 72. Soil from a pot of Cultures 90 which has recently [illegible]. The [illegible] of [illegible] when knocked out of the pot has a ~~sour~~ offensive odor like that of a pig pen. Titration [illegible]

Soil 73. Soil from a pot of Cultures 90, which has not yet [illegible], but is growing well, possibly due to [illegible] more shade than the other pot. Same offensive odor. Roots [illegible] [illegible] of [illegible] [illegible]. Titration [illegible]

March 22 19[illegible]

Culture 20. Bud on one graft grown [illegible] to [illegible] Isabe branch 2. cm. in length. One 16 mm., one 9 mm.

Culture 71. [illegible] [illegible] planted in the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] half grown and [illegible].

Culture 63. The plant [illegible] [illegible] buds nearly ready to [illegible] and [illegible] this morning with ~~the~~ one [illegible] [illegible] with [illegible] fruit.

Culture 14. No new [illegible] [illegible] [illegible] [illegible]. Of the [illegible] [illegible] of new shoots one is 4 cm long and still growing.

Culture 15. [illegible] in [illegible] [illegible], [illegible] [illegible], in [illegible] [illegible] [illegible] with an [illegible] of coarse crock in the [illegible] [illegible] [illegible] [illegible] of [illegible] [illegible] [illegible] the crock.

March 23, 1907.

[illegible] still [illegible]. The last of the 15 plants on the window sill have started to push their buds. No new roots are yet evident.

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March 24, 24

Culture 120. One of the breaking buds is withering at 9 mm.

Culture 132. This number is given to the plant of Culture 66 in a enlarged glass glass pot, a cutting of October 15 '23, which was mulched with peat on March 22. Its first flower ~~has~~ opened this morning.

March 2[illegible]

Culture 9[illegible]. All [illegible] plants have [illegible] growth, [illegible] by basal [illegible]. There is no green [illegible] [illegible].

Culture 95. All [illegible] are [illegible] with [illegible] practically no growth. Basal [illegible] have [illegible] [illegible] [illegible]. These plants are forming [illegible] from the green covering of [illegible] in the [illegible].

Culture 96. In all [illegible] plants growth has been resumed. The [illegible] of the [illegible] [illegible]. There is no green [illegible].

Culture 97. The [illegible] [illegible] and [illegible] [illegible] green [illegible] on the [illegible].

Culture 1[illegible]. [illegible] [illegible] green [illegible] only [illegible]. The green [illegible] [illegible].

Culture [illegible]. [illegible] [illegible] [illegible]

Culture [illegible]. [illegible] [illegible] and somewhat [illegible].

[illegible]

Culture 41A Making good new root growth, but the [illegible] and [illegible] entering dormant.

Culture 84 The purpling of the leaves is lessening and growth has begun

Cultures 15 & 17. The leaves have remained green or only slightly purple and considerable growth

has been made. Green algae on 15 = 17 & 128, not on [illegible], 122, 123

Cultures 122, 123. Some of the plants beginning to ~~wing~~ [illegible] from their purpling and growth beginning.

Culture 124. Have gone as purple as 123

Culture 123, [illegible] Most of the [illegible]

122 & 123

Culture 126. No green growth

Culture 127. Green algal growth like 116

Peat water

First titration, beg. fermentation 3.5 cc.

Second " March 22 11 cc.

Third " " 25 12 cc.

BPI

March [illegible]

[illegible] 132. First flower pollinated to-day [illegible] pollen. [illegible]

Second flower pollinated [illegible] pollen.

April [illegible]

Pollinated a fifth flower to-day.

April 5, 1907.

Pollinated a sixth flower to-day.

April 6, [illegible]

[illegible]

[illegible]

March 26, 190[illegible],

Culture 28b. The [illegible] [illegible] [illegible] growth on any of the ~~glass [illegible]~~ [illegible] [illegible] plants shows to-day in this plant.

Culture 31. Plant trimmed back to stubs to-day, four stems being cut off of the following lengths. 7.3 cm., 11. cm., 20.4 cm., and 31.1 cm.

Culture 30. Plant trimmed back to stubs to-day, the longest branch being 30.1 cm.

Culture [illegible]. The window sill plant of this culture, [illegible] in 5 inch pot, now has 66 buds started, 4 of them being flower buds, and the longest of [illegible] leaf ones [illegible] being 7 mm., yet no root growth has yet taken place.

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WASHINGTON, D. C.

March 2[illegible], 1907

Cultures 15. The first new root growth in what was originally the field mulch of the pot 19 in culture are seen today. One is 1.5 mm the other .8 mm long!

Sphagnum held plants. All the plants have [illegible] except one planted [illegible] [illegible] [illegible] [illegible] [illegible] 41.

March [illegible], '[illegible]

[illegible] W[illegible] [illegible] Bar[illegible] [illegible] [illegible] visited the blueberry house to day and gave the following [illegible] them.

He has been [illegible] [illegible] [illegible] [illegible] huckleberries for [illegible] [illegible].

He [illegible] [illegible] [illegible] [illegible].

He has been [illegible] [illegible] [illegible] crates of 16 quarts [illegible], which he [illegible] in Chicago until July 1 for $[illegible]

His berries [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] as 2 or 3 [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] his [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] about a [illegible] [illegible] [illegible]

His berries [illegible] [illegible] [illegible] [illegible] [illegible] has [illegible] [illegible] [illegible] [illegible] the [illegible] either in [illegible] or [illegible]

He [illegible] his [illegible] huckleberries in the [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] making berries [illegible] and a [illegible] [illegible] [illegible] larger [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

On [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] 12 [illegible] [illegible]

He has not a large [illegible] [illegible] [illegible]. He [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
(over)

His method of crossing plants is to tie two flowers together very tightly, he has not had success in transferring pollen.

His greatest success in cultivation has been in a spot on a [illegible] bog [illegible] that weeks and then plants will not grow.

Upon my suggestion that I would like to see his methods of [illegible], Col. [illegible] said that he would be glad to [illegible] and to show me the plants. Afterward he [illegible] that the best time to see the plants would be in the fall after the flowers were dead, when the [illegible] would be [illegible] and the plants in good shape for [illegible] [illegible].

April 2, 1907

Culture 113, Several new roots to-day

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March 27 '09

Culture 65. Several new roots 2 to 3 mm long to day.

Culture [illegible] Plants [illegible] [illegible] transplanted [illegible] the [illegible] [illegible] on the 26th.

Culture 134. Thirty five plants from Culture 69 transplanted March 25, 1909 into a flat at a distance of 2½ inches from each other in a soil of peat & sandy loam.

Culture 135. Twenty seven plants of Kalmia latifolia from Culture 67 were planted March 24 [illegible] into thumb pots and plunged in sphagnum. Soil of peat & sandy loam. In this [illegible] out [illegible] the [illegible] [illegible] 5 to 7 [illegible] leaves [illegible] [illegible], the [illegible] [illegible] [illegible] [illegible] mm from the [illegible] 10 to 15 mm.

Culture 120. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] grown

upper [illegible] leaf [illegible] [illegible] 3 cm
The branch on the other graft is still
growing. In both the leaves are yellow-
ish green.

Of the two green shoots recently
made by this plant one is forming a
terminal bud at 22 cm from the
moss, being 3.5 mm in diameter at
the moss and having produced 42
leaves above the moss. The other is
25 cm long from the moss, 3.5 mm
in diameter at the moss [illegible] 50 [illegible]
above the moss, and has lost its
tip by browning and drying.

[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible],
though the stem is still alive.

[illegible]

[illegible]. [illegible]
[illegible]
[illegible]

[illegible]. [illegible]
[illegible]
[illegible]
[illegible]
[illegible]

[illegible]. [illegible]
[illegible]
[illegible] brown leaf [illegible]

[illegible]. [illegible]
the dead leaves coming to day.

[illegible]
[illegible]
[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]. One of the [illegible] of [illegible] [illegible]
[illegible] now has been 11-12 mm
[illegible]

Culture 15. Plants now with many [illegible]

April 2, [illegible]

Culture 47A Gave this number to the southernmost 4 rows of culture 17, 26 plants. Watered them with about 500 [illegible] of cow manure water from the tanks. The remaining 26 plants of [illegible] will be untreated.

April 2, 1909

Culture 136 Two short cuttings from the Brooks bush received Feb. 9, 1909, and since kept dormant in moist sphagnum, were recut to-day and submerged horizontally in the ~~live~~ growing sphagnum of Culture 69

Manure water titrated after boiling .4 cc.
before boiling 4. cc.

April 2 1908.

Culture 120 A. The middle plant in the aquarium is given this number to-day.

Culture 120 B. The plant in the aquarium grafted with *Vaccinium par-* [illegible] is given this number. The [illegible] is [illegible] and the graft looks in good condition but the buds are not yet growing. The shoot growing [illegible] is 40 cm. high from base [illegible]. The uppermost five [illegible]. The [illegible] as [illegible] flowering buds

[illegible] of 55 B and one of 55 [illegible] to be [illegible] (Erwin F.) to-day.

April 3, '07

Culture 53. Flowering buds opened sufficiently to show the flower buds. A few of the leaf buds a centimeter in length, on some cuttings hardly started.

Culture 56. A few of the plants show a moderate puffing of the old leaves. Several show puffle mottlings.

Culture 55. A few show puffling, a few puffle mottling, the latter associated apparently with yellow and thicker mold.

Culture 57. A few show puffle mottling, partly from red spider and partly not.

Culture 121. No puffling as yet.

Cultures 126 and 127 with a trace showing. [illegible] of [illegible], conspicuous among the cultures in 5 inch pots 114 to 119,

Professor Munson. Mr. May the gardener who did most of the potting, employed by Col. Brackett and Prof. Munson [illegible] of the greenhouse [illegible]. Mr. May answered all he could. Professor Munson's inquiries in regard to the soils used in potting.

April 5, 1909

Culture 115. Some of the new roots are at least 12 mm. long. The second set of new branches are not [illegible] their tips. One of them is 6 cm. long, another 5 cm.

Culture 15. New root growth is taking place in all the four beakers, though the buds are ~~[illegible]~~ barely pushing.

Culture 22. Root growth in all experiments [illegible] one rapidly growing plant.

Culture 23. Root growth good in all, very vigorous in one plant that had made new growth and stopped before transplanting to the beakers. New roots, at least 10 mm. in one case.

Culture 24. Very slight new root growth

Culture 25. New root growth up to 3 mm. in one of the beakers

Culture 26. New root growth in all up to 2 mm.

Culture 28. New root growth abundant in two, up to 5 mm., these plants having made and stopped new growth during the winter. Two shows no new roots [illegible] growth.

April [illegible]

Culture 67. One plant has made no growth from the original cutting, and ~~[illegible]~~ not very large root growth.

One plant has made three good branches, the longest 7.5 cm long, all with tip withered and wood now ripening.

Two plants ~~have~~ are making a long branch (still growing) ~~shoot~~ from a lower bud, and the original flowering buds on the cutting are pushing out flower buds.

Culture 68. Two plants are making what appear to be flowering buds on their ripening branches.

Culture 41 A. The first sign of stem growth is the pushing of a green tip from a basal bract of one of the flowering buds.

Ripe berries. The 1907 plants in the sphagnum bed now bear 16 ripe berries.

Culture 137. Six cuttings from Culture 44, made [illegible] first ~~[illegible]~~ branches, placed horizontally [illegible] in the growing sphagnum of Culture 69. Three of the cuttings wholly submerged [illegible] with all [illegible] leaves [illegible], three with tips [illegible] 1 or 2 [illegible] cm

April 6, 1921

Culture 121. The growing bud on this graft has [illegible] the graft [illegible] a union with the stock [illegible] place at the base of the [illegible] ~~but the~~ [illegible] evidently [illegible] to the scion to furnish nourishment.

Ripe berries. Nineteen ripe berries on the 1707 plants in the sphagnum bed.

Culture 138. Forty plants of Kalmia latifolia, from Culture 69, potted yesterday in a flat at 2 1/4 inches in pure kalmia peat.

Culture 139. Twenty-eight plants of Kalmia latifolia, from Culture 69, potted today in [illegible] pots in pure kalmia peat, to be plunged in live sphagnum.

~~[illegible]~~

[illegible] 40 [illegible] one-third
~~[illegible]~~ One, one-third [illegible] size.
[illegible] *Catonia*

~~Three~~ two [illegible], one enlarged

[illegible]

[illegible]

[illegible]

Two pots, one [illegible]
photographed when [illegible].

[illegible] 71-73.
[illegible]

[illegible] 73
[illegible] natural size

[illegible] 75
[illegible] size

[illegible]
[illegible] size

[illegible]
[illegible]

[illegible] ~~[illegible]~~ two [illegible]
[illegible]
[illegible]
4 [illegible]

[illegible]

B P I

[illegible] 6.0 cm. long [illegible]
[illegible]
[illegible] 3.3 cm. long.

[illegible] cm. long. [illegible]

[illegible]

April [illegible]

Culture 570. During the [illegible] this [illegible] [illegible] months from the [illegible] [illegible] has made a flower- [illegible] terminal bud [illegible] [illegible] shoot in the axil of [illegible] [illegible] first basal branch [illegible] subtends an actual flower [illegible] as determined by dissecting it.

[illegible] of the [illegible] have [illegible] buds that appear to be [illegible] buds. They occur on [illegible] [illegible], in the [illegible] [illegible] similar bud in the [illegible] [illegible] ner

[illegible] appear [illegible] producing flowering [illegible], but the cases are [illegible]

Culture 43. [illegible] on a 1 cm. [illegible] flowering bud on [illegible] of the first [illegible] branch of the plant. No [illegible]

[illegible] flowers pollinated on this [illegible] next branch [illegible] growth [illegible] plant is now taken place [illegible] making general ~~[illegible]~~ growth and has but not more [illegible] two of which [illegible] ated to-day, marked with two [illegible]

April [illegible]

Culture 120 B. The layered branch that was severed from the parent several weeks ago, and which dropped its leaves suddenly afterward, is dead. It had developed a large callus at the sides ~~point~~, and four root points, but nevertheless was unable to pull through.

The <u>Vaccinium</u> <u>parvifolium</u> graft is uniting and its buds are dormant.

Culture 128. Grafts growing satisfactorily, one with 5 leaves, including the green bracts, the other with 6.

Cult., 133 April 3, '11

One of the cuttings had [illegible] yesterday. Eleven of the cuttings in flower today, the flowers nearly cylindrical. Some cutting with shoots up to 3 cm long, and as many as 7 green veined bracts and leaves.

Smilacina [illegible] Huckleberry bushes. In flower, the leaf buds [illegible]

Same length as the [illegible]

Flowers 6-8 mm long, greenish or pinkish white. Leaves [illegible] in the bud.

April 16, 1909

Culture 140. This is the ~~number~~ amber given to the window sill plant of Culture 41. The first flowers are open this morning, in a nine-bud raceme. The new branches have made good growth, some of them being 3.0 cm. long. Fifty-five leaf buds on this plant have actually grown on this plant and four flowering buds. One flowering bud and two leaf buds have swollen but have not yet developed any growth.

Plant knocked out of the pot this afternoon. The soil broke in two at the base of the old root ball, and the roots were clearly seen not to have started.

Apr. 19, 1909

Eleven flowers are out to-day, and two more flowers have been pulled off, probably by birds.

April 20, 1909

Twenty-three flowers out to-day. Longest new branch 5.5 cm.

Apr. 21

No more flowers out to-day. No sunlight.

Apr. 22

Sunny, 26 flowers open.

Apr. 23

Cloudy, 26 flowers open —— (over)

(Over

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Apr. 24

Twenty-seven flowers out to-day. Pollinated twenty-six, one being broken off accidentally. Six corollas were detached, the flowers being probably too old to pollinate; the styles however remained on.

The plant was knocked out of the pot and the surface of the original ball examined, but no new root growth has taken place. The apex of one of the

Plant photographed to-day and Apr. 20

new branches is 3.5 cm long, and with its leaves reaches 60 cm. Its tip has not withered. Twenty-seven ~~new~~ branches on the plant have grown tho, several of them however showing a reduced leaf rudiment evidently preparatory to withering. See note on 41 A, this date.

April 17, 1907.

Sugary secretion from glandular hairs on the backs and basal margins of leaves. This occurs to-day on plants at the office as follows:

Culture 140

Culture 29 b.

Culture 29 a

Culture 15

Culture 6

Culture 2 b

Culture 2 a

Culture 113

Culture 114

Of these plants culture 2a and 2b [illegible] [illegible] [illegible] [illegible], and [illegible] [illegible] [illegible] [illegible] [illegible]. these two are [illegible] [illegible] [illegible].

All these plants are growing chiefly on stored food

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April [illegible]

Culture [illegible]. Forty four [illegible] of Culture 56 began to [illegible] [illegible] [illegible] [illegible] [illegible] the [illegible] pot, leaving 36 plants in Culture 56.

Culture 47 A. Watered with [illegible] water April 2, 10, 17. The [illegible] on these plants appear [illegible] [illegible] vigorous than those in Culture 47

Culture 56. Growing tips [illegible] on [illegible] plants, of these 1[illegible] over 10 cm. long, 2 [illegible] over [illegible] cm. long.

Culture 56 A. Growing tips 115 on the 44 plants, of these [illegible] over 10 [illegible] long, none over 20 [illegible]

Culture 47 A. Growing tips 49 on the [illegible] plants, of these [illegible] long [illegible] 10 cm long

Culture 47 Growing tips [illegible] on the [illegible] plants, of these 16 over [illegible] 10 cm. long.

[illegible]

[illegible] bushes. In full flower, many [illegible] [illegible] [illegible] [illegible]. Glands on the midrib and lower [illegible] [illegible] many cases giving a [illegible] [illegible] [illegible] [illegible] Stumps of one amputated trunk 8.5 cm. [illegible], [illegible] [illegible] living trunk 21 cm in circumference. [illegible]

April 12 [illegible]

Culture 133. Ten cuttings [illegible] fairly [illegible], 7 these [illegible] callus, 5 a small callus

Culture 81. Repotted in [illegible] inch pots, April 6. in [illegible].

Culture 90. Repotted ~~[illegible]~~ in 4 inch pots April 6, in [illegible].

Culture 64. Transplanted from the flat into 4 inch pots in [illegible] loam, on April 17, 31 plants

Culture 65. Transplanted from the flat into 4 inch pots in [illegible] loam, on April 17, twenty-two plants after taking out 65 A. Growing tips 35 [illegible] 10 cm

Culture 65 A. Twenty plants taken out of Culture 65 and [illegible] with manure water [illegible]. Growing tips 35, 9 over 10 cm long.

April 20 1909

Culture 113. Plant showing some new roots, evidently ~~[illegible]~~ a week or more of age.

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April 20, 1909.

Wilting point of Vaccinium corymbosum.

The plant of Culture 89 recently photographed stood without watering and to-day when its ~~leaves~~ were withered but still flaccid, a test of the soil moisture was made. ~~With its~~ The soil was broken away from the plant and crumbled into a beaker. The soil and beaker weighed 149.82 grams.

Apr. 21, 1909

Weight to-day, after drying in air 146.85

Apr. 23, 1909

Same 145.35

Apr. 27, 1909.

Weight to-day, after drying in an oven at since April 23. 143.8

Weight of beaker 127.73

Water therefore 37% of the soil weight

Apr. 23, 1909

Dr. Shantz determined the moisture in another sample plant in four-inch pot (Culture 90) at the wilting point as 7.4%.

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April 20, 1909

Culture 31. Plant repotted to-day in pure kalmia peat in a liter beaker. No new roots yet, the leaf buds ~~bursting~~ growing, the largest 1 cm. long.

Culture 18, window sill plant. Repotted in kalmia peat in a liter beaker to-day. No new roots yet, the last year's growth profuse. New branches 3.6, 3.3, 3., and 1.8 cm long

~~3.6 1.8~~
3.3
3.0

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April [illegible]

[illegible]

[illegible] will give [illegible]

[illegible]	[illegible]
A 3	B 5
B 1	B 4
T 3	[illegible]
C 4	D 1
H 4	M 5
I 2	G 5

[illegible]

[illegible]

These [illegible] + G 5

[illegible]

and first [illegible]

the [illegible]

M [illegible] follows

[illegible]

[illegible] 5, 7, 8, 25 [illegible]

B P I

[illegible]

[illegible] cm.

[illegible]

[illegible] cm.

[illegible]

[illegible], 6.5, 1.2 cm.

No fertilizer plants, as follows:

B5 – One ripened branch, 19 cm.
Three soft branches, 2, 12, 2.5 cm.

B4 Two ripened branches, 5, 21 cm.

D3 One ripened branch, [illegible] cm.
One maturing branch, 20 cm.

D1 One ripened branch, with flowering bud in uppermost apil, 13 cm.
One maturing branch, 20 cm.

M5 – One ripened branch, with maturing continuation, both together 21 cm.
Three soft branches, withered, 15, 12, [illegible] cm.

G5 – One ripened branch, with maturing continuation, together 14.5 cm. [illegible] a flowering bud.
Two soft branches, [illegible] 18, 16.5 cm.

April 20 19[illegible].

Culture 72 A. Thirty-five plants out of the seventy in culture 72 are taken out and made into 72 A. The plants are so selected that the number and length of growing shoots is as follows.

Culture 72, 92 shoots, 36 of them over 10 cm. long, 6 of the 36 over 20 cm. long.

Culture 72 A, 92 shoots, 36 of them over 10 cm. long, none over 20 cm.

Culture 72 A will be watered at intervals with [illegible] water [illegible] growing [illegible] To-day

[illegible] 47. Growing shoots [illegible] of 2[illegible] 10 [illegible]

[illegible]

Culture 47 A Growing [illegible]

[illegible]

[illegible]

Culture 45 [illegible]

[illegible] two of the [illegible]

[illegible]

[illegible] 133 [illegible]

[illegible]

[illegible] 127 [illegible] especially [illegible]

[illegible]

[illegible] further [illegible]

[illegible]

[illegible]

April [illegible]

Culture 141–143. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] and [illegible] [illegible] Col. [illegible] [illegible] [illegible], [illegible] [illegible] [illegible].

Culture 141. Rooted plant of the variety "[illegible] Belle", Buds swelling. Soil [illegible] [illegible] [illegible] black, [illegible] [illegible] [illegible]. Potted in pure kalmia peat in a (4 inch) pot and placed out doors. Col. Banks' ~~[illegible]~~ [illegible] of this plant as follows:

[illegible]

Culture 142. Rooted plant of the variety [illegible] "Wilson". Potted in a 6 inch pot in pure kalmia peat and placed out doors. Buds swelling. Col. Banks [illegible] of this plant: [illegible]

Culture 143. Cuttings [illegible] [illegible] [illegible] [illegible] variety [illegible] "[illegible] [illegible] Garden". Placed in the cutting [illegible] with Mr. [illegible] [illegible] [illegible] [illegible]. Col. Banks [illegible] [illegible]. [illegible]

[illegible]

Letters 177. Cutler [illegible] "Indian No-
menclature" [illegible] [illegible]
Bamboo [illegible]: [illegible]]

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

FROM

DELMONARDA FRUIT GARDENS

GRAND JUNCTION, MICH.

WILL H. S. BANKS, PROPRIETOR

HIGH BRED AND GRAFTED HUCKLEBERRIES A SPECIALTY.

A LIMITED NUMBER OF ORDERS OF NOT OVER 12 PLANTS WILL BE RECEIVED AND FILLED THIS FALL.

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

FROM

DELMONARDA FRUIT GARDENS

GRAND JUNCTION, MICH.

WILL H. S. BANKS, PROPRIETOR

HIGH BRED AND GRAFTED HUCKLEBERRIES
A SPECIALTY.

A LIMITED NUMBER OF ORDERS OF NOT OVER 12 PLANTS
WILL BE RECEIVED AND FILLED THIS FALL.

Thomas [illegible], [illegible]
[illegible]
[illegible] in the [illegible]
William, [illegible]
[illegible]
[illegible]

FROM

DELMONARDA FRUIT GARDENS

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WILL H. S. BANKS, PROPRIETOR

Blue Bell

HIGH BRED AND GRAFTED HUCKLEBERRIES A SPECIALTY.

A LIMITED NUMBER OF ORDERS OF NOT OVER 12 PLANTS WILL BE RECEIVED AND FILLED THIS FALL.

[illegible]

FROM

DELMONARDA FRUIT GARDENS

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WILL H. S. BANKS, PROPRIETOR

HIGH BRED AND GRAFTED HUCKLEBERRIES A SPECIALTY.

A LIMITED NUMBER OF ORDERS OF NOT OVER 12 PLANTS WILL BE RECEIVED AND FILLED THIS FALL.

April [illegible]

[illegible] 130. Plan[illegible] [illegible] the [illegible] [illegible] bottle [illegible] [illegible] Rube [illegible]. A [illegible] [illegible] [illegible] the [illegible] [illegible] have [illegible] a [illegible] now [illegible] [illegible] [illegible] [illegible] [illegible] and [illegible]

[illegible] [illegible]. Graft [illegible] [illegible] [illegible] summer. The [illegible] [illegible] a scion [illegible] [illegible] [illegible] the [illegible] [illegible] [illegible].

On the shoot [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] buds [illegible] the [illegible] [illegible], five of the buds next [illegible], [illegible] [illegible] on the [illegible] [illegible], [illegible] [illegible] budding [illegible] [illegible]

[illegible] 120. The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the other 16 [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] 19[illegible]

[illegible] 3, [illegible]
[illegible]. The [illegible]
[illegible]
[illegible]
The [illegible]
[illegible]
again [illegible]

Fruiting [illegible] in the [illegible]
on the [illegible] 7 [illegible]
in [illegible] 12 mm. [illegible]
Picked 7 ripe [illegible]

[illegible] 89A. Twenty [illegible]
[illegible] Culture [illegible]
[illegible]
[illegible] 20 cm.
[illegible] not growing 21.
none; [illegible]
[illegible] growing tips
[illegible].
18, [illegible]
17, [illegible]; because not growing

31 Smithsonian blueberry bushes. Corollas beginning to fall. Standing water about the south bush.

[illegible] 14 [illegible] 3

April 24, 1909

Culture 41 A. This plant, which was photographed to-day, shows stem growth ~~at~~ only two points, one a leaf bud which put out a branch that withered, [illegible] its [illegible] having reached a fair sized leaf, the other a short [illegible] from one of the lower scales of a flowering shoot. This shoot now has [illegible] about 15 cm. long and is still growing. The roots, ~~of the plant~~ as shown after knocking the plant out of the pot, ~~[illegible]~~ have a rather abundant new growth reaching to the bottom as ~~[illegible]~~ well as the sides of the pot. See note of to-day on Culture 140.

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April 2[illegible] [illegible]

Peat treated with lime water by [illegible]

5 gr. soil air dried required 190 cc. lime water before an alkaline reaction was obtained

1 liter lime water = 1.25 grams CaO

1 cc. " " = .00125

Soil therefore 4¾% lime when air dry

Culture 77A A plant of Culture 77 (peat soil) was removed out of the pot and the soil ~~[illegible]~~ washed carefully off the roots. The plant was then repotted in pure kaolin [illegible] and given one watering with ammonia water.

The main stem of the plant is 3 cm. high, the tip ~~[illegible]~~ stagnated ever since 77 was potted, and except the [illegible] immature leaves of the stag-nating tip, the stem was [illegible] with [illegible] leaves but three. There is also a [illegible] slender 5 leafed basal branch of 2.5 cm. height. The roots are very limited in extent ~~of~~ having made none of [illegible] growth since 77 was potted.

Apr. ~~25~~ 26, 1939

Cutting 47 Branches with apex over 20 cm. long growing one, terminated ~~s~~ three.

Cutting 47A Branches with apex over 20 cm long growing, four; terminated, five

Cutting 55. Branches with apex over 20 cm long growing, one, terminated, none

Cutting 55A. Branches with apex over 20 cm long, growing, four; terminated, none

Cutting 55 B. Branches with apex over 20 cm long, growing, one; terminated one

Cutting 33. Took out three more blackened cuttings, two with a slight callus one not,

April 26

Cutting 13[illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the upper ten buds [illegible] flowering buds. The eleventh is a leafy [illegible], and the next two flowering buds.

Cutting 135. All the plants but 5 are living and now showing new growth. In one the rosette is 23 mm. in diameter, the longest leaf having a length of 13 mm.

Cutting 53. Three plants have small flowering buds all on the ultimate axillary [illegible] the first basal branch, one of them [illegible] a second flowering bud also. More plants about to be starting flowering buds. The plants which perfected most after potting in 4" pots are not making flowering buds.

Cutting 5[illegible]. [illegible] plants have [illegible] flowering buds, the ultimate axillary one in the first basal branch

Cutting 47A. One plant with flowering buds.

Cutting 47. Four plants with flowering buds.

Cutting 50. Three plants with flowering buds.

Cutting [illegible]. [illegible] plant with flowering buds.

Cutting [illegible]. [illegible] plants with flowering buds.

Cutting [illegible]. Six plants with flowering buds

B P I

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April 27, 1909

"Soil" 74. Peat water from the barrel. 200 cc titrates 20 or $\frac{50}{100}$ (= 1/2) % normal

The barrel has been watered since titration 69 was made, but the peat water has been used so that the concentration is again large.

April 29, 1909

Soil 75. Sandy subsoil bearing [illegible] growth [illegible] Vaccinium. Lanham April [illegible] 1909. East edge of [illegible] Titrated .2

Soil 76. Top soil over soil 75, after [illegible] forest leaves are scraped off. Titrated 1.3

Soil 77. Top soil in Brush lot, west of [illegible] orchard. Heavy growth [illegible] Titrated 2.4 [illegible]num.

Soil 78. Sandy soil in [illegible] of Collins [illegible] [illegible] plants [illegible] [illegible] .4 [illegible] and [illegible] [illegible] 78.

Soil 79. [illegible] from [illegible] .6

Soil 80. Bare [illegible] and lichen [illegible] in Collins woods. Upper half [illegible] .6 [illegible]

(over)

[illegible]

Soil 81. Pure [illegible] [illegible], from a culture 25 plants kept in my window [illegible] [illegible] [illegible] all winter, 1.5

May [illegible]

[illegible]

May 5 [illegible]

[illegible]

May 10, 1907.

Soil 55. [illegible] from the rich woods [illegible] [illegible] [illegible] Prunus [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] ~~[illegible]~~ alkaline. [illegible] Carbonate 1%

May 13, [illegible].

Soil [illegible]. Loam from the greenhouse. [illegible] since [illegible] [illegible] (See [illegible] + 59) .4

Soil 67. Same [illegible] [illegible]. [illegible] since [illegible] (See [illegible] + 60)

Soil 85. [illegible] from the greenhouse. [illegible] since M[illegible] 5 with peat water [illegible] .5 [illegible] 6.)

Soil 81. [illegible], from [illegible] (See 63) [illegible]

April 2? 193?

Culture 117. These ten [illegible] are ~~[illegible]~~ ~~[illegible]~~ [illegible] [illegible] [illegible] from any [illegible] 3-inch [illegible] cuttings from 11? [illegible] 119 and from 122 to 129. [illegible] are [illegible] in [illegible] and [illegible] no [illegible] growth [illegible] any sort ~~[illegible]~~ [illegible] have ~~[illegible]~~ [illegible], the longest being 2 [illegible].

Culture 137 One of the cuttings [illegible] was found to be [illegible] and was [illegible]. No [illegible] had been formed, only a small [illegible]

[illegible] had and [illegible] been removed. No [illegible].

Culture 141. [illegible], [illegible] growing [illegible]

Culture 142. Apparently dying

Apr. 27, 1909.

Culture . . Ova . . . . day, . one of them

about 7 mm. long

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April 12, 1930.

Hypomicrogium [illegible] on all my [illegible] of Culture 95, specimens from one of the [illegible] having been [illegible] by Mr Britton, and [illegible] of the [illegible] of Cultures [illegible]. I [illegible] also ~~found~~ on all 5 [illegible] of 074 and [illegible] of Cultures 67, 65, 100, 34 & 35. It occurs abundantly all over that part of the plate occupied by Culture 100, sparingly in 106, and not at all in 99. [illegible] in some of the [illegible] ~~[illegible]~~ sparingly with [illegible] It occurs [illegible] not at all in 105

6. Two [illegible] of [illegible] with [illegible] of Hypomicrogium, [illegible] from Culture 100.

7. Sarracae [illegible] 141 [illegible] not [illegible] Culture 141 [illegible] a small [illegible] of [illegible] like Culture 146 [illegible] Culture 141. Same as [illegible]

April 30, 1909.

Window sill plant of Cutting 25. Still in large drinking glass. Had an extensive root system last year, but no new root growth has started this year. Of the buds that started, all have lost their tips and most have withered. The plant looks very sickly. A test is to be made to ascertain the acidity of the soil. The soil is a pure kalmia peat, and has had no drainage.

May 1 '09

Cutting 133. Two cuttings with wilted new shoots 1 to 2 cm long removed from the box to-day. Both ~~[illegible]~~ brown and dead on the outside from the base to the surface of the sand, the pith still green. Cut ends blackened, slightly callused.

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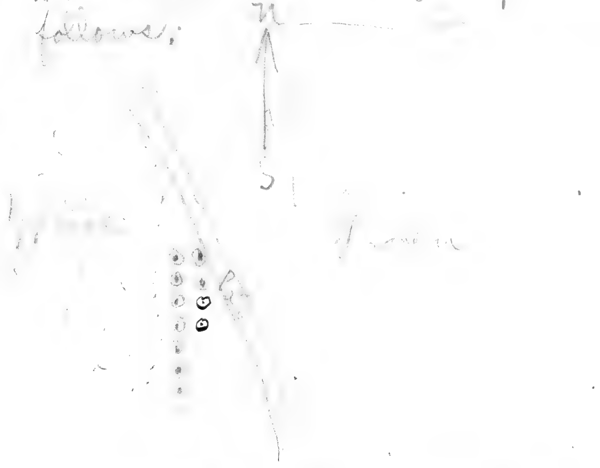
Aug. 24.

Lanham

Set out seven plants of Culture 51 on Mr. Scofields plat, finishing the west row of 12.

Set out nine plants of Culture 51 on Mr. Collins plat west of the garden, as follows:



(Box set with the top about two inches [illegible] of the [illegible]

Plants indicated by ink marks set out May 16, 1909, Culture 53.

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May 3, [illegible]

Smithsonian blueberry bushes.

Flowers mostly gone. Those with corollas still remaining fresh are pendant, but the pedicels of young berries, from which the corollas and styles have dropped are curved upward.

The new twigs are now up to 6.5 cm. in length (one measurement). No sugar globules were seen on the leaves.

[illegible] no. 130. Another bottle of lime water was set on May 1. New [illegible]

Aug. [illegible]

[illegible] 78. The [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible]. The [illegible] is [illegible] [illegible] [illegible],
and has made no [illegible] [illegible]. [illegible]
~~[illegible]~~ ~~[illegible]~~ it was placed on the glass.
ever since
[illegible] [illegible] [illegible] [illegible] [illegible] and [illegible]
[illegible]. One [illegible] has [illegible]. The [illegible] [illegible]
all ~~[illegible]~~ ~~[illegible]~~ [illegible] and have been
so ~~[illegible]~~ since [illegible] [illegible] [illegible]. The
color is [illegible] [illegible] [illegible]. The
upper [illegible], [illegible] [illegible] [illegible], [illegible] [illegible]
[illegible] [illegible] the uppermost the largest
about .5 mm in length.

[illegible]

[illegible]

[illegible]

[illegible] The [illegible]

[illegible]

7 am

[illegible]

[illegible] 1917

Cutting 12[illegible]. [illegible] the [illegible] [illegible] [illegible]
~~sent~~ out roots from the lower part of the
shoot within the ~~sphag~~ [illegible]. In [illegible] cases
and probably in all the root emerges
from the [illegible] stem at a point
immediately above a rudimentary bud,
~~[illegible]~~ in turn [illegible] immediately above a
leaf [illegible] of the stem. One of these roots was
[illegible] [illegible] light brown [illegible]
and [illegible] [illegible] length of 5.5 mm.

Cutting 133. The [illegible] growing in two cuttings ~~[illegible]~~
having turned yellow [illegible], the cuttings
were taken out. Neither has a callus. In both the bark is alive
above the sand but below the surface ~~[illegible]~~
brown and dead. The wood and pith
however are still green in one, the
pith only green in ~~[illegible]~~ a part of the other,
and the whole stem including the pith
brown in the remaining part.

A third cutting with green but drooping new
leaves is slightly callused but dead at the
base, the [illegible] dead from the base about
half way to the surface of the sand.

Another taken out for microscopic [illegible]
[illegible].

May 5, 1930

Cutting 18, wing cutting. The leaves on the tender shoots of this plant are withering today in the brilliant sunlight. The plant has made no new roots whatever since the winter. The new shoots are up to 5.6 cm long. It is the nearly full grown leaves that are succumbing, not the two or three next the growing tip.

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May 5, 1907

Culture 140. This and other plants on the window sill show conspicuously the exudate of sugary drops from glands along the midrib on the back of the leaf and on the margin of the leaf toward the base.

The exudate occurs also on Cultures 2a, 2b, 6, 15, 17, 22, 25, 29a, 29b, 113 (very sparingly, and perhaps formed sometime ago) 441A. It is wanting on 18, 24, 30, 31, 145, 114. Culture 24 is feeble, 114 and 145 have roots and the leaves also are rather immature, and 18, 30 and 31 have only basal shoots with rapidly growing glandular pubescent herbage.

The exudate was tested by Mr. Jacobs of the Bureau of Chemistry, with Rochelle salts and sulphate of copper, and found to be not sucrose. About 50 of the globules were used for the test, all from Culture 140.

The plant (Culture 140) was knocked out of the pot, and after a careful examination no new root growth was found in the new peat in which the plant was potted this spring. A few new roots 2 to 4 mm. in length were found, however, within the surface of the old ball. The plant was put back again in the same pot and soil.

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May 6, 1909.

Cuttings in water still, a few new roots 2 to 3 mm in length have observed in this place.

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Aug [illegible]

Culture 66. Transfer of this [illegible] [illegible] from a drained drinking glass to a [illegible] pot in green [illegible] [illegible].

Culture 132. [Same as [illegible] culture 66]

May 7, 1937

Cutting 57. Four plants potted in peat. 4 inch pots.

Cutting 58
Cutting 59
Cutting 60
Cutting 61
Cutting 62

[illegible]

Cutting 88. Twelve plants potted in peat. 4 inch pots.

[illegible] and [illegible]

[illegible]

[illegible]

[illegible]

May [illegible]

[illegible] — 1 bottle of
lime [illegible] May 8,
[illegible], Several [illegible] plants, and
1 [illegible] [illegible] [illegible], in the
Sphagnum [illegible] making [illegible]
[illegible] [illegible]) the [illegible] shoots
having [illegible]
and [illegible] [illegible]
[illegible]
[illegible]
making new shoots

[illegible]

[illegible]

[illegible]

[illegible] (shed) [illegible]

[illegible] 129, V[illegible] [illegible]

[illegible] Cond. [illegible]

[illegible]

Wilson, 137. Cuttings [illegible]

[illegible] their [illegible]

[illegible] 133A

[illegible]

May 10, 1907.

Culture 31. The two large roots of this plant (apex 8.5 and 9.5 cm long) ~~with tips 8.5~~ are drooping to-day, though the weather is cloudy. Yesterday was sunny but the awning was down. The plant shows no new roots.

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[illegible]

[illegible]

[illegible] Glendale, Md.

May 1 [illegible]

Culture 7, [illegible] [illegible] [illegible]. Began [illegible] [illegible] [illegible] [illegible] May 7. Two fresh buds have formed in the axils of the two leaves nearest the top.

[illegible]

May 12, '07.

Cultures 108 to 114 were gone over to-day and all wood and leaves containing the cockle-leaf mite were cut off.

[illegible]

[illegible] These [illegible]

few [illegible]. One of the new [illegible]

[illegible]

[illegible]

[illegible]. Seven [illegible]

[illegible]

May – [illegible]

Culture [illegible] B. Two plants of this culture are the tallest ~~biggest~~ of any of ~~[illegible]~~ the [illegible] seedlings. One of them has a shoot with one [illegible] [illegible] long to-day, eight [illegible] from the [illegible] [illegible] of the seed.

May 15, 1908

Culture 130. Another bottle of lime water finished this morning.

Culture [illegible]. A very few [illegible] [illegible]
[illegible].

G. & G.

May [illegible]

[illegible] On [illegible] [illegible] [illegible] [illegible]

[illegible]

May [illegible]

[illegible] 150. [illegible] pieces of [illegible] about 2 inches long and 1/3 inch in [illegible] made [illegible] rags [illegible] [illegible] from [illegible] [illegible] brush. The cuttings [illegible] planted [illegible] [illegible] with [illegible] [illegible] [illegible] at [illegible] [illegible], [illegible] about 2 inches of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] and night [illegible]

Brooks bush   May 19, 1909.

To-day had Mr. Doyle photograph sixteen berries out of the bottle of berries from the Brooks bush kept in formalin since last August.

Of the berries photographed eight were 13 to 14 mm. berries, eight 12 to 13.

The bottle contains thirty berries, as follows:

11 to 12 mm.	13 berries
12 to 13 mm.	9 berries
13 to 14 mm.	8 berries

The two or three largest berries almost caught in the 14 mm. hole.

Culture 67. Plant photographed to-day, with flower on a new shoot grown from a bud on the cutting.

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May 20, 1919.

Soil 90 Cow manure that has been lying out all winter at the left greenhouse in a thick pile, Now full of striped worms. Used in growing compost in Culture 155A and 153. 1.2

Soil 91. Coconut fiber, moldy, some two years 3.4

Soil 92. Coconut fiber, two years, greenhouse benches. .4

Soil 93. Cow manure, fresh from Lanham. 4. (approximately)

May 20, 1919

Soil 94. Culture 70, containing worms .5

Soil 95. Culture 70, containing worms .5

Soil 96. Culture 71, no worms .8

Soil 97. Culture 71, no worms .8

May 22

Soil 98. Peat mixture (peat 8, sand 1, loam 1) used in cultures 151 & 152. 1.5

[illegible] 1911.

[illegible] 151 Same [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
in comparison [illegible] Cult. 152.

Cult. 152. Same as [illegible]
[illegible] fine [illegible]
[illegible]

Cultures 70 and 71. In some of the pots the earthworms have worked and the soil instead of being granular has superfluous water [illegible] of clay. This soil has evidently been through the alimentary [illegible] of earthworms

May 21, 1909.

Culture 140. Most of the new branches have withered their tips and all apparently are preparing to do so. The uppermost branch on the main stalk is 11.2 cm. long, and with a withered tip. The longest branch ~~on~~ this stalk, also with withered tip, is 12.5 cm. long.

The small old twigs at the base of the plant are trimmed off to-day.

Knocked out of the pot the ~~ball~~ plant shows active root growth in a cavity next to the old ball. The new roots have not yet, however, reached the surface of the new ball.

May 27, '09.

Culture [illegible].

All the early branches have ~~stopped~~ withered their tips. The longest is 13.5 cm. One branch from near the base 15 cm. long is still growing.

June 14, 1909.

Culture 140. The ultimate buds on some of the upper twigs of the season, which withered their tips some time ago, have started to make ~~a~~ new growth

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BPI

May 21 [illegible].

~~Cuttings 67, 67A, [illegible], 103, 104~~

Cutting 35. Three plants. [illegible] in [illegible], [illegible] one [illegible] [illegible] [illegible].

Cutting 67. Four plants. [illegible] [illegible] [illegible]]

Cutting 67A. Five plants. [Same]

Cutting [illegible]. Three plants. [Same]

Cutting 103. Seven plants. [Same]

Cutting 104. Three plants. [Same]

May 22. 1907.

Cutting 43. [illegible] plants. [illegible] May [illegible] [illegible] [illegible] and [illegible] [illegible] [illegible] in [illegible] in a [illegible] same [illegible] [illegible] [illegible] of [illegible], [illegible] [illegible] [illegible], [illegible].

Cutting 47 plants. [Same [illegible] [illegible] [illegible] [illegible] 20]

~~Cutting [illegible] A]~~

Cutting 49A. plants. [Same [illegible] [illegible]]

Cutting 55 plants. [illegible] [illegible] [illegible] [illegible] date, May 21]

Cutting 55A [illegible], [illegible] [illegible] six inch [illegible] in [illegible] 7, [illegible] [illegible] [illegible]

(cont'd) and plunged ~~[illegible]~~ [illegible] sand in a cold frame, with a little shade [illegible] covering.

Culture 153. The six tallest plants of Culture 55A, repotted in six inch pots in peat 7, manure 1, sand 1, loam 1, with rocks [illegible] between the [illegible] ball and the [illegible] of the pot. Plunged in sand in a cold frame with little shade [illegible] covering. The apex of the longest shoot on each plant measured 10.5, 11, 11, 11, 14, and 14.5 inches.

Culture 67A. When [illegible] plants [illegible] potted [illegible] it was found [illegible] [illegible] [illegible] was [illegible] [illegible] [illegible] out of the pot, while the [illegible] [illegible] in all the other cultures [illegible] (Culture 67) [illegible] development [illegible] [illegible] [illegible] and [illegible] [illegible] [illegible] [illegible] uniform [illegible] leaves.

The manure used for this culture and Culture 55A was cow manure from the pile that has been lying out all winter at the greenhouse. As soil it titrated acid 1.2. In order to kill the earthworm eggs with which it abounded it was spread out in an oven for six hours at a temperature of 65°C., the soil itself attaining a temperature of 50°. This is believed to have killed the eggs.

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May 22, '07.

Window sill cultures.

Conspicuous new rooting in several of the glass pots, that have heretofore shown no roots, is observed to-day. These pots, rooting and not rooting are noted as follows:

Culture 6. Many new roots, 4 mm. or less in length in all parts of the pots. First spring growth of the tops stopped some time ago. Secondary growth now starting.

Culture 15. Many new roots a few millimeters in length have developed especially toward the bottom of the pot and on the side away from the sun. Two spring branches are continuing their growth.

Culture 17. No new roots can be seen through the glass. After knocking out the ball, examining the glass and replacing the ball a very few new roots are discernible near the bottom crock. New growth has stopped and has not been resumed.

Culture 22. Many new roots are to be seen, in all parts of the pot, up to 1 cm. in length. Spring growth had stopped but is now resumed.

Culture 24. No new roots in either of the pots, even in the heavy mulch of one containing a mass of old roots.

Culture 25. No new roots though some of the spring growth still continuing slowly.

Culture 21a. Several very short new (very) roots coming in

(over) the sphagnum overlying the sand. New growth starting.

Cutting 29b. Many new roots starting, nearly all in the sphagnum above the sand. First growth of tops stopped, second not yet started.

Cutting 31. No new roots on the outside. Shoots still growing from the cut stumps of the old wood, the longest about 13.0 cm long, and in this cloudy weather not wilting.

Cutting 30. No new roots on the outside. Shoots still growing from the cut stump, the longest 120 mm.

May 27, 1909.

Culture 132. Berry red-purple to-day.

May 28, 1909.

Berry ripe to-day.

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August 1907.

Oct. 10. The [illegible] [illegible] [illegible] better. The two [illegible] grafts [illegible] [illegible] The [illegible] graft is swelling. The [illegible] [illegible] [illegible]

The shoot is now 7 cm. long.

On May 25 & 2[illegible] [illegible]

[illegible]

and removed [illegible]

[illegible] the [illegible]

[illegible]

The [illegible] in the [illegible]

[illegible]

Culture	114	24.
	115	10
	116	7
	117	10
	118	10
	119	6
	122	19
	123	21
	124	24
	125	4
	126	23
	127	13
	128	23
	129	23

Culture 114. These plants are the [illegible] any in the 114–119, 122–129 culture. [illegible] is 7 cm.

Culture 127. These plants [illegible] now [illegible] most vigorous of any in the [illegible] cultures 114–119, 122–129. They have [illegible] 20 cm [illegible] and [illegible] of growth is especially characterized [illegible] Some of the plants [illegible]

May [illegible], [illegible].

[illegible] 133. Seven [illegible] [illegible] [illegible] their
[illegible] and for the [illegible] part [illegible]
[illegible] were [illegible] [illegible] [illegible]
with [illegible] [illegible] [illegible] [illegible] [illegible]

G. & G.

May 21 [illegible]

[illegible] Bro. [illegible] [illegible] May 23, [illegible]

May 7 '97

Now in cold frame the following.

Cuttings #3	67	plants ? in pots
47	26	" " "
47A	26	" " "
55	30	" " "
55A	20	" " "
55B	20	" " "
153	6	" " "
35	3	plants 5 inch pots
67	4	" " " "
67A	5	" " " "
68	3	" " " "
103	7	" " " "
104	3	" " " "
88	12	plants 4 inch pots
65	22	" " " "
65A	20	" " " "
89	26	" " " "
89A	25	" " " "
64	31	" " " "
34	2	plants 5 inch pots
90	52	plants 4 inch pots
112	10	plants 4 inch pots (potted May 7)
112A	10	" " " "

May 29, 1919.

Windowsill cultures. Transferred the following from undrained to drained 3-inches glasses to-day: 6, 15, 17, 22, 24(2), ~~[illegible]~~ 29a, 29b, 30; and the following from 3-inch pot, drained, to 3-inch glasses: 2a, 2b. ~~[illegible]~~

Cultures 2a & 2b were given a top covering of half alive sphagnum.

Culture 29a ~~[illegible]~~ had the old soil and all the leaves [illegible] cut off, then the plant covered lightly with half live sphagnum.

Culture 29b had the old soil washed off and the whole covered lightly with half live sphagnum.

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May 29, 19[illegible]

Culture 112 B Ten plants potted in [illegible], still in greenhouse.

May 29, '37

Cultures 47 + 47A measured to-day, as follows:

47

[illegible] mm	2125	4289
	[illegible]	180
250	217	[illegible]
177	163	168
205	207	205
237	[illegible]	190
1[illegible]	192	5260
1[illegible]0	238	
187	175	
2[illegible]0	162	
260	170	
	155	
2125	4289	

26) 5260 (202
52
60

Average height 202 mm.

47A

210 mm	2[illegible]	4699
213	225	243
231	195	270
275	285	2[illegible]2
2[illegible]	195	2[illegible]0
[illegible]	215	285
2[illegible]	212	247
230	270	6256
2[illegible]	230	
2[illegible]	200	
	2[illegible]0	
2442	4699	

26) 6256 (241
52
105
104
16

Average height 241 mm

May [illegible]

Culture [illegible] Two plants repotted from 4 in to 5 inch pots. [illegible] (peat [illegible], Plunged).

May [illegible]

Kalmia peat

Twenty barrels of fresh kalmia peat received yesterday and today.

Cultures 108 + 109 etc. These are withstanding better than 110, 110A, 111 and 112. Culture 108 has made a little better growth than 109. Cultures 110 and 110A are perhaps no worse than 111 and 112 but they are of a paler color, the last two having their leaves heavily purpled and yellowish green. The length of the tallest branches (measuring only new growth and [illegible] on account of the [illegible]) is as follows:

108
190 mm.
183
1[illegible]
2[illegible]
2[illegible]
275
2[illegible]
170
180
182
140
145
172
92

14) 2599 (186
14
119
112
79

Average height 186 mm.

109
190	2686
205	184
127	205
225	165
146	122
175	164
155	152
137	124
135	82
160	185
134	126
105	155
10[illegible]	128
1[illegible]	135
140	178
1[illegible]	152
[illegible]	150
[illegible]5	3090
1[illegible]	347
1686	

34) 3090 (149
34
169
136
330
306
24

Average height 150 mm

(over)

Over

110
75
123
136
120
[illegible]
135
115
130
120
108
120
120
[illegible]
90
[illegible]
1734
44

15)1734(116
15
23
15
84

Average 117 mm

110A
105
79
[illegible]
135
123
[illegible]
95
78
[illegible]
[illegible]
[illegible]
85
113
[illegible]
65
104
70
1764
66

1764
132
85
125
103
85
95
2389
32

23)2389(104
~~207~~
~~319~~
~~207~~
~~2~~
89

Average 104 mm.

111
95
142
77
152
133
130
98
117
97
95
120
100
62
120
95
1623
85

1623
[illegible]
80
85
76
132
[illegible]
2241
133

21)2241(107
21
141

Average 107 mm.

111A
100
132
105
97
70
123
100
[illegible]
94
[illegible]
[illegible]
108
102
1401
45

1401
110
95
92
[illegible]
[illegible]
85
[illegible]
2073
132

Average 104 mm.

20)2073(104
20
73

May 2? 1?? [illegible]

Cultures 56 and 56A. Cultures 56A is [illegible] [illegible] larger and with more growing tips and with more [illegible] leaves than 56. The average height of the [illegible] is as follows.

56

115 mm.	2427	48[illegible]
	210	[illegible]
150	[illegible]	[illegible]
125	[illegible]	152
232	183	[illegible]
205	1650	2[illegible]
[illegible]	240	196
112	230	253
140	170	250
[illegible]	157	230
203	220	6698
220	[illegible]	
165		
160	1[illegible]2	
1[illegible]	15[illegible]	
2427	4865	

36) 6698 (186
 36
 309
 288
 218
 216

Average 186 mm.

56 A

152 mm.	3975	7455
	168	23[illegible]
222	183	1[illegible]
2[illegible]0	186	185
183	2[illegible]	205
180	[illegible]	310
168	217	3[illegible]
2[illegible]	2[illegible]	196
230	[illegible]	9088
2[illegible]	1[illegible]	
[illegible]	177	
1[illegible]	1[illegible]	
[illegible]	1[illegible]	
[illegible]	[illegible]	
1[illegible]	[illegible]	
2[illegible]	2[illegible]	
[illegible]	322	
[illegible]	1[illegible]	
[illegible]	165	
3975	7455	

Average 211 mm

43) 9088 (211
 86
 48
 43
 58
 43

May 30, 1909.

Culture 55 + 55A. The relative size of plants is as follows.

55

	1550	3332	5088
137 mm.	217	187	160
175	217	235	235
[illegible]	180	205	212
137	178	235	5695
[illegible]	198	232	
185	160	292	
110	217	202	
255	190	178	
198	225	5088	
1550	3332		

29) 5695 (196
29
279
261
185
174

Average height 196 mm.

55A

187 mm.	1709	2813
[illegible]	243	112
[illegible]	~~[illegible]~~	155
[illegible]	~~149~~	204
[illegible]	185	242
156	[illegible]	152
[illegible]	~~[illegible]~~	3708
[illegible]	185	
150	174	
[illegible]	207	
1709	2813	

20) 3708 (185
20
170
160
108
100

26) 5543 (213
52
34
26
83
78

Average height 213 mm.

Also of Culture 55 (Family 55...)

360 mm.
385
270
275
275
270
6) 1835
300

55B

	2497
270 mm.	165
310	205
242	225
153	180
275	175
233	170
190	222
125	2[illegible]
230	215
217	4319
243	
2497	

20) 4319 (216
40
37
[illegible]
[illegible]
120

Average height 216 mm.

Syracuse, N.Y.
June 3, 1907.

Blueberry meadow

Ten rows of holes ~~D~~ 8 x 8 feet prepared by [illegible] by chopping up the ground to a diameter of 18 inches with a grubbing hoe.

Tenth and ninth rows (from west) 21 plants each planted with Cuttings #9. Plants from [illegible] [illegible] [illegible].

Eighth row, 22 plants, planted with [illegible] [illegible], starting with [illegible] and [illegible] [illegible].

Seventh and sixth rows 24 plants each set with Cuttings 151, but the plants trimmed each shoot being cut back [illegible] to [illegible] its length. Shoots [illegible] [illegible] [illegible] [illegible] [illegible].

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Greenfield, N.H. June [illegible]

Orchard [illegible]

Seventh year from seed.
First fruit [illegible]

Sixth year from seed.
First fruit [illegible] (7 [illegible])

Fourth year from seed.
First fruit [illegible]

In the orchard plantation, say [illegible] years old, a considerable number feeble. Many are growing well, some having already made twig growth of 5 cm.

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B P I

Soil 99 Loam, same as soil 86, but given ~~water~~ only water, no peat water, since May 13. June 4 '09 .1

Soil 100. Sand, same as Soil 87, but given only water, no peat water since May 13. .1 Neutral

Soil 101. Leaf mold same as Soil 88, but given only water, no peat water since May 13.

Soil 102. Peat mixture from pot of Culture 70 Alkaline .7

Soil 103. Earthworm experiment from the surface of Soil 102. 1.0

Soil 104. Peat mixture from a pot of Culture 71. .9

Soil 105. Earthworm experiment from the surface of Soil 104. 1.1

Rowbow 8 Row 1
Plant 1 from ... Plant 1 from ...
Feeble ... Fair
2 ... 2 Fair
3 " 3 Feeble
4 " 4 Flowering from one third
5 Fair 5 Fair
6 " 6 Good
7 " 7 Feeble
8 " 8 Fair
9 Feeble 9 Fair
10 " 10 Feeble
11 " 11 Fair
12 " 12
13 Good 13 Feeble
14 Feeble 14 Fair
15 Fair

Row 10
Plant 1 (from south) Feeble 13 ~~Feeble~~ Fair
2 " 14 "
3 " 15 ~~Feeble~~ Feeble
4 Fair 16 Fair (... sphagnum)
5 " 17 "
6 Feeble 18
7 Fair 19 Feeble
8 " 20 Fair
9 21
10 Fair 22 Good
11 Feeble 23 Feeble
12 Fair 24 Fair

25 Fair
26 Flowered from ...

117
143
32

17

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Greenfield, N.H. June

Orchard blueberries

First (south) row, east end

First Good
2 "
3 Feeble
4 Fair

Second row
First Good
2 "
3 "
4 "

Third row
1 Fair
2 Good
3 Fair

Fourth row
1 Good
2 "
3 Fair

Fifth
1 Fair
2 Good
3 "
4 Fair

Sixth
1 Good
2 "
3 Flower from 1 bud
4 Fair
5 Good

Seventh
1 Good
2 "
3 Fair
4 Good
5 Flower
6 Fair

Eighth row
First Fair
2 Good
3 Fair
4 Good
5 "
6 Fair

Ninth
1 Good
2 "
3 "
4 "
5 "
6 Flowering from 1 bud

Tenth
1 Good
2 "
3 Feeble
4 Fair
5 Good
6 Fair

Eleventh
1 Fair
2 Feeble
3 Good
4 Fair
5 "
6 "

Twelfth
1 Fair
2 Fair
3 Fair
4 Good
5 Feeble
6 Fair
7 "

Thirteenth row
1 Fair
2 "
3 "
4 "
5 "
6 Good
7 Fair

Fourteenth
1 Fair
2 "
3 "
4 "
5 Feeble
6 "
7 Fair

Fifteenth
1 Fair
2 "
3 "
4 "
5 "
6 Good
7 "

Sixteenth
1 Feeble
2 Dead
3 Fair
4 "
5 "
6 "
7 "

Seventeenth
1 Fair
2 "
3 "
4 Feeble
5 Fair
6 Good
7

Eighteenth row
1 Flowered, 1 bud
2 Fair
3 Fair
4 Fair
5 Fair
6 Fair
7 Fair
8 Fair

Nineteenth row
1 Fair
2 Feeble
3 Fair
4 "
5 Feeble
6 Fair
7 "
8 "

Twentieth row
1 Feeble
2 Feeble
3 Fair
4 Dead
5 Fair
6 Fair
7 Feeble
8 Dead

Twenty first row
1 Dead
2 Feeble
3 Fair
4 Dead
5 Fair
6 Feeble
7 Fair
8 Dead

(over)

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Twenty second row
1 Fair
2 Feeble
3 Fair
4 Feeble
5 Fair
6 Dead
7 Fair
8 Feeble

Twenty third row
1 Feeble
2 Fair
3 "
4 Feeble
5 "
6 "
7 Dead
8 Feeble

Total plants 173
Dead 7
Removed 4

Greenfield June 4, 1909.

Blueberry meadow continued from yesterday

Fifth row set with plants of Culture 72A, shaded with [illegible] [illegible]chamum

Twenty-four plants in row, not trimmed

Fourth row, twenty-five plants, set with Culture 72, each shoot trimmed back about a third, shaded with [illegible] [illegible]chamum

Third row, 25 plants, south 19 holes set with Culture 46, north 6 with Culture 45, not trimmed, shaded with [illegible]

Second row, 24 plants, set with cult 44 [illegible] not trimmed

First row, six plants, [illegible] [illegible], shaded with [illegible] not trimmed

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Greenfield N.H. June 4, '07

Brooks bush
Self-pollinated ~~th~~ three branches on the Brooks bush to-day. First removed all the open flowers that had been pollinated. Then pollinated the few flowers that had just ~~been~~ opened, but the stigmas of which had as yet received no pollen. Removed one calyx lobe from each of the pollinated flowers. Then tied up each branch in thin cloth(   ) so as to keep out insects. Will the buds pollinate themselves?

The well developed flowers on this bush are 10 x 7 mm. and the calyx lobes are very short and rounded, about twice as broad as long.

Flowers taken to pollinate bush at the farm.

Stanley bush.
Pollinated 1 flower with Brooks bush pollen.
" another " " " "

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[illegible]

Planting [illegible] [illegible] [illegible] of 1935.
Planted [illegible] [illegible] [illegible]

Row 1 ([illegible] west)
Plant 1 [illegible] [illegible] ~~[illegible]~~

2
3 Growing [illegible]
4 [illegible] [illegible] [illegible]
[illegible]
5 ~~[illegible]~~ (40) [illegible]
6 [illegible] [illegible] [illegible] been [illegible]
7 [illegible] [illegible]
8 [illegible]
[illegible] [illegible] [illegible] [illegible]
9 [illegible] [illegible]
11 [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]
12 [illegible] [illegible]
13 [illegible] [illegible] one [illegible]
14 Growing [illegible]
15 " "
16 [illegible] fair
17 [illegible] [illegible]
18 [illegible] [illegible]
19 [illegible] [illegible] [illegible]
20

Plants [illegible] 17 [illegible]

[illegible] [illegible] [illegible] Plants [illegible]
6 [illegible] (50)
7 Fair
9 Flowering
buds (3) [illegible]

[illegible] 18 [illegible]
13 [illegible] 14 [illegible]
[illegible] (53)
15 Fair
[illegible] Fair

[illegible] on two [illegible]
[illegible] [illegible] [illegible]

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Row 3
Plant 1 (from south) Fair
2 Good
3 Fair
4 Good
5 Fair
6 Good
7 Good
8 Good
9 "
10 Fair
11 Good
12 Fair
13 Fair
14 Flowering bulb(?) nearly ready to [illegible]
15 Fair
16 "
17 Good
18 Feeble ([illegible])
19 Flowering from one bulb.

Row 4
Plant 1 (from south) Good
2 Fair
3 Flowering bud pushing
4 Flower in bud nearly ready to [illegible]
5 Good
6 Fair
7 Fair
8 Fair
9 "
10 [illegible]
11 Fair
12 Feeble
13 " [illegible]
14 Fair
15 "
16 Feeble
17 " [illegible]
18 " [illegible]

Row 5
Plant 1 (from south) [illegible]
2 Fair
3 Feeble
4 Fair
5 Feeble
6 Feeble
7 Fair
8 Fair
9 Feeble ([illegible])
10 Feeble ([illegible])
11 " ([illegible])
12 Fair
13 "
14 Feeble ([illegible])
15 Good
16 Dead [illegible]
17 Fair

Row 6
Plant 1 (from south) Fair
2 "
3 "
4 "
5 Feeble
6 "
7 "
8 "
9 Fair
10 Feeble ([illegible])
11 Feeble
12 "
13 Fair
14 Fair
15 Dead ([illegible])
16 Feeble

Row 7
Plant 1 (from south) Fair
2 Feeble (44)
3 Good
4 Fair
5 "
6 Feeble (44)
7 Fair
8 Fair
9 Fair
10 Feeble (44)
11 Fair
12 Good
13 Feeble (44)
14 Fair
15 "
16 "

Beginning at [illegible] end.

1	Feeble	11	Fair
2	Fair	12	[illegible]
3	Feeble	13	Good
4	"	14	Feeble
5	Fair	15	Fair
6	"	16	"
7	Feeble	17	"
8	"	18	"
9	Feeble	19	"
10	Fair		

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[illegible] 15' and [illegible] June [illegible], 19[illegible]

[illegible] found [illegible]

Only one worm (a very [illegible]) found in any of the

pits.

[illegible] June [illegible]

[illegible]

[illegible] new [illegible]

12 [illegible]

June [illegible]

Culture 99 [illegible] measured [illegible] as follows:

173 mm.	105	155
155	165	12[illegible]
168	150	2[illegible]
1[illegible]	153	164
1[illegible]	220	2[illegible]
172		1[illegible]

[illegible]) [illegible] (17[illegible]

Average 17[illegible] mm.

Culture 100. Heights [illegible] as follows:

128 mm.	82	106
11[illegible]	97	113
[illegible]	97	2[illegible]
100	1[illegible]	
10[illegible]	85	
75	1[illegible]	

[illegible]) [illegible] (10[illegible]

Average 10[illegible] mm.

Culture 101 heights [illegible] as follows:

175 mm.	150	2[illegible]	1[illegible]
2[illegible]	16[illegible]	1[illegible]	
153	1[illegible]	98	
1[illegible]	1[illegible]	176	
160	1[illegible]	152	
114	162	1[illegible]0	

[illegible] 20) 3 [illegible] 6 [illegible] (153

20

106

100

69

60

Average 153 mm.

[illegible] the [illegible] of 99 are distinctly [illegible] and [illegible] stems notably thicker than those of 101

[illegible] The length [illegible] [illegible] [illegible] (17 3/4 in.) [illegible]

(17 3/4 in.)

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
WASHINGTON, D. C.

June 10, 1909.

Precipitation, lime.

In connection with the possible precipitation of lime from the lime water with which Culture 130 has been watered, in the upper layers of the earth in the pot, which is suggested by the appearance of the soil and the roots in one of the pots, Mr. Breazeale to-day took an acid peat soil (Soil 14), moistened it, then stirred into it dilute lime water ~~into~~ reddened with the phenolthalein, and immediately poured the mixture into a filter. Ten seconds elapsed from the time when the lime water was mixed with the soil to the time when the liquid began to come through the filter. It came through without a trace of red color, showing that the lime had been precipitated out.

Subsequently he poured ~~into~~ the moist soil in the filter an additional amount of the reddened lime water, and it came through ~~so~~ ~~of~~ clear, in four seconds.

The precipitation of the lime is practically instantaneous.

June 10, 1939

Culture 130. A new [illegible] [illegible]
begun about June 3, is [illegible] [illegible]

Culture 70. [illegible]
[illegible] of [illegible]
[illegible] mm. in length and 9 mm.
in [illegible]

~~June 14 19[illegible]~~

June 11, 19[illegible].

Culture 133. Took up the seven remaining cuttings today. Five were rooted. These five were potted; the other two put back in the propagating bed.

The 5 rooted plants were put in thumb pots in old soil & glass covered, potted [illegible] [illegible], and placed under a shaded ventilated bell-jar.

Culture 130 June 12, 1909.
A plant of this culture examined today.
Top layer about 3 mm. thick alkaline, without boiling.

Next layer, about 15 mm. thick, no roots at margin, alkaline after boiling.

Third layer, about 4 mm. down, containing brown and dead roots, dying next to the rootless zone. Slightly alkaline on June 14.

Fourth layer, about 5 mm. down, the surface bearing a dense layer of live roots, the inferior with few but live roots. Distinctly acid on June 14.

Fifth sample, at depth of 4 to 7 mm., along the label, no roots, alkaline after boiling.

Sixth sample, from the bottom immediately [illegible] the cracks. Distinctly acid on June 14.

The surface of [illegible] depth of 1 or 2 millimeters is gray and lime-encrusted.

The upper part of the soil, for a depth varying at different points of the circumference from 1.5 to 3.5 cm contains no roots. Along the label all the way to the bottom of the pot are no roots. At all other parts of the surface of the ball, including the bottom among the cracks there is a dense covering of live roots.

The plant is 230 mm. high (4th stem) and has two new shoots 1.5 + 2.5 long.

Samples 3, 4 and 6 did not show an alkaline

(over)

reaction on drying after treatment with water and [illegible]. They will be showed to them over until June 16 for a more careful test.

Shall begin watering Culture 4/130 with a new bottle of lime water to-day.

Samples of roots from this plant were taken to-day and preserved in solution.

Near the lime-[illegible] gone, the [illegible] appear more inclined to [illegible] the stag-horn form.

June 14, '08.

June 1[illegible], 19[illegible]

[illegible] brown. Some of the berries ripe. Many of the growing tips and younger leaves [illegible] [illegible] [illegible] after the [illegible] [illegible] [illegible] and [illegible] [illegible] [illegible]. Berries very [illegible] [illegible] [illegible].

North bush [illegible] berries [illegible] [illegible] bush with berries [illegible] with a [illegible] bloom.

June 16, 19[illegible].

Blueberries on market. Blueberries (huckleberries?) from South Carolina have been in the whole-sale market for about two weeks, and have sold by the ~~box~~ crate at 8 to 12 ¢ per quart box, according to condition. They were evidently picked with a rake. Individual berries were found, as large as the New Jersey berries.

Kalmia latifolia June 17, 1909

1 ~~a~~ Peat 8, sand 1

2 ~~b~~ " " , crocks

3 ~~c~~ Peat 8, sand 1, manure 1, crocks

4 ~~d~~ " " " "

5 ~~e~~ " " " "

Plants from Bobbink & Atkins.

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BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

E. Springfield [illegible] June 27/1901

First ripe blueberries (Vaccinium pennsylvanicum) [illegible] Davis pasture.

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BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Greenfield. June 29, 19[illegible]

Mr. Frank Russell's Place. Budded as follows:

Celestia. First tree northeast of corner of barn, about 60 yards. Five buds.

Jefferson. Tree about 60 feet a little west of south from the Celestia tree. Five buds.

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WASHINGTON, D. C.

[illegible]

Blueberry [illegible].

First row from [illegible]

Plant 6 from south, new planting Culture 45, about [illegible]

" 10 has [illegible] new shoots up to [illegible] cm long, and still growing.

[illegible] has 2 [illegible] [illegible].

Second row

Plant 4 has 5 [illegible] [illegible]

Third row

Fourth row

Fifth row

Plant 5, new planting, Culture 50, has made new twigs since planting, up to [illegible] cm.

Plant 6, same 5.3 cm. [illegible].

Plant 7, same, 6 cm. new twig

Sixth row

Plant [illegible], new planting, Culture [illegible] new growth 9.5 cm

Plant 6, numerous twigs up to 9 cm

Plant [illegible], ~~new~~ planting, Culture 50, 3 vigorous shoots from a vigorous cut back stem, the longest now 10 cm. long and growing rapidly.

Seventh row

Plant 3 has 4 fruits set.

Plant 4, 2 fruits set

Eighth row

Plant 2, numerous twigs from near summit of [illegible] stem, up to 7 cm long.

Greenfield, June 30, 1909
(Con. 2)

Eighth row (con.)

Plant 5, numerous twigs up to 10 cm. long.
Plant 6, " " " 14 cm. long from died-back stems.
Plant 7, shoot twigs from died-back stems, up to 17 cm. long.
Plant 8, same as plant 2.
Plant 9, same as 8 and 2.
Plant 14, with 10 green berries
Plant 17, same as 9, 8, & 2, but twigs up to 10 cm.
Plant 18, new planting, Culture 50, flower ready to open in a few days
Plant 19, with 2 green berries.
Plants of this row averaging better than any of the other rows.

Ninth row

Plant 4, with 1 green berry.
Plant 9, in flower, old plant Lot 1, 5 belated flowers. Dead twigs show that on this plant, as doubtless on many others, flowering buds that formed on these plants were later ~~killed~~ lost by the death of the twigs, either through last autumn's drouth or by winter-killing.

Tenth row

Plant 5, with 15 green berries, on new twigs.
Plant 6, fine one
Plant 10, with 9 green berries
Plant 14, with two green berries withering on account of injury to the twig.

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Greenfield, June 30, 1909
(Con. 3)

Tenth row (con.)

It appears that out of the planting of 1908 in this meadow 10 plants set fruit this year, this being a percent of . The plant with pleated flowers, ninth row, plant 9, may also set fruit.

The growth of vegetation in the ploughed land, rows 2 to 8 and plants 1 to 13 of row 9 is much greater than in the area not plowed, the removal of encroaching ~~weeds~~ weeds from the mulched circle of ~~...~~ 1½ to 2 feet diameter about each plant requiring the expenditure of probably 5 times more time than on the non ploughed area. The weeds encroaching are particularly Potentilla canadensis, Fragaria virginiana, Rubus ——, Rubus , Agrostis and Poa pratensis. It is not clear that the plants in the ploughed area are better than those in the unploughed area.

Eleventh row (beginning of new planting) (all Cuttings 49)

Only a few of the set plants in this row have made any new growth. They have the same appearance as the pot bound or acid choked plants of the greenhouse, with many purpled leaves and reddish foliage. The plants

[illegible], June [illegible]
(Cont.)

Eleventh row (Con.)
of Cultures 570 used in replacing the dead or
feeble plants of rows [illegible] to 10 show no such
symptoms, nearly all of them showing a healthy
color and good growth. The plants in row
11 eleven were not mulched with leaves, and
at first sight the difference may have been
due to dryness, but some of the plants in
the rows are in low ground, still moist
to the surface, and these plants are in
still worse condition, having lost many of their
lower leaves. Whether well [illegible] or not,
also, the plants in new-chopped soil
suffered. It is believed that these plants
are suffering in the same way as the
acid choked plants in the raw peat cul-
tures of the greenhouse.

That the apparent acid-choking may be
in essence a nitrogen starvation phenom-
enon is a possible explanation of the results
of these two plantings. From the [illegible]
[illegible] in the [illegible] of the weeds in the
ploughed tract as well as on general grounds
it is inferred that nitrification has
gone on much more actively in the

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Greenfield, June 30, 1909

Eleventh row (con.)

(con. 5)

ploughed than in the unploughed area. Nitrification would be still less in the still more acid ~~=~~ conditions of the newly chopped soil.

In the ideal field plantings of next year it is good three kinds of soil should be tried, in good sized holes from which the original soil was been removed, (1) peat kept a year under cover, (2) new peat, (3) new peat with a small amount of manure added.

The best shade for plants just set out is pine branches, by far.

Twelfth row (Culture 49)

The plants of this row are in the same condition as those of row 11. Only two of the 21 in the row have made any new growth.

Thirteenth row (Culture 131)

Condition similar to rows 11 + 12, only 6 out of 22 plants showing any new growth, and the plants in moister spots having the leaves more feeble or having lost more of them

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WASHINGTON, D. C. Greenfield, June 30, 1909
(Kon. 6)

Fourteenth row (Culture [illegible])
The condition of these plants is much better than that of rows 11, 12, and 13, 16 out of 24 plants showing ~~good~~ new growth, and most of these good color also. It was this row 14 in which the branches were pruned back to about ~~one-third~~ one-third to one-half their length when planted out early in the month.

Fifteenth row (Culture 131)
Seventeen out of 24 show new growth.
The plants in this row also were cut back.

Sixteenth row (Culture 72 [illegible])
Plants not cut back when set out.
Plant 3, [illegible] well. Leaves all shed, stems alive below
Plant 15. Leaves all shed, stems alive
Plant 17. " " " " " below
Plant 18 " " " " " "
Plants in this row ~~[illegible]~~ in much the same condition as rows 11 + 12, only 7 out of the 24 showing any new growth whatever and that mostly feeble.

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Greenfield, June 30, 1909 (con 7)

Seventeenth row (Culture 72)

Twenty five plants, all cut back. Nineteen have made ~~good~~ new growth. Most of the plants that have made new growth have made it recently, ~~[illegible]~~ the leaves of the plants having first turned purple and the plants subsequently recovered from their seed-checking.

Eighteenth row (Cultures [illegible] [south 19] and 45 [north 6])

Plants not cut back, 25 in number. Ten plants show new growth, mostly feeble. Plants resembling in condition rows 11 & 12.

Nineteenth row (Culture 44)

Twenty four plants, not cut back. Nine show new growth, others like rows 11 & 12

Twentieth row (Culture 44)

Six plants, cut back. Five show new growth.

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WASHINGTON, D. C. Springfield, June 30, 19[illegible] (Con. 8)

Plants set in 1909 in ground prepared in 1908.

Row 1, nine plants (Cultures 44 [2], 45 [2], 72 [2], 72A [3]) Plants all started new growth

Row 2, ~~(Culture 45)~~ 3 plants (Culture 45). Two have made new growth

Row 3, 2 plants (Culture 44). ~~Neither~~ One has made new growth, ~~though~~ both look well

Row 4, 4 plants (Culture 44). All have made new growth

Row 5, 6 plants (Cultures 50 [4], 44 [2]). All have made new growth. Especially have the plants of Culture 50 make a vigorous growth.

Row 6, 8 plants (Culture 50). All have made new growth, in most cases vigorous.

Row 7, 6 plants (Culture 50). New growth, mostly vigorous, on all.

Row 8, 1 plant (Culture 50). New growth, vigorous

Row 9, 5 plants (Culture 50). New growth on four.

Row 10, 4 plants (Culture 50). New growth on three.

In all these new plants in rows 1 to 10, only an occasional plant was cut back. In not a single instance is a plant ~~badly~~ conspicuously purpled, or otherwise in bad condition, even though it has made no new growth.

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Essenfield, June 30, 190[illegible].

The characteristic shrubs ~~plants~~ of the meadow are alder, willow, and Spiraea salicifolia, with Vaccinium pennsylvanicum and Lycopodium complanatum in the higher spots, and [illegible] in the [illegible] places.

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[illegible]

Row 1 [illegible]
[illegible] 1 [illegible]
2 thrifty
3 [illegible]
4 [illegible]

Row 2, all 4 thrifty, shoots [illegible] 15 cm

Row 3, all 3 thrifty

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Plant 2
26 cm [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] feeble
35 — thrifty.

[illegible]

Row 19, 1 thrifty, 2 feeble, 3 [illegible]

[illegible] 1 & 2 rather feeble [illegible] 6 [illegible]

thrifty.

Row 20, 1 weak, 2 thrifty, 3 [illegible]

6 [illegible] thrifty, 8 dead.

Row 21, ~~1 weak~~ dead 3 [illegible] feeble, [illegible]

[illegible] thrifty, [illegible]

[illegible] thrifty, [illegible]

Row 22, [illegible] 2 [illegible] thrifty, [illegible]

6 thrifty, 7 dead, 8 feeble.

[illegible]

[illegible]

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Greenfield, July [illegible]

Blueberry [illegible]

Plant of Culture 45 [illegible] Row 1 Plant 6, [illegible] this [illegible] Two more buds nearly ready to open.

Plant of Culture 50, Row 8 (Plant [illegible]) [illegible] Pollination.

Greenfield July [illegible]

Plant of Culture 45, pollinated July [illegible], had [illegible] pollinated to-day. These [illegible] all the flowers [illegible] this year.

Plant of Culture 50, pollinated July 4, had lost its pollinated flower to-day.

Greenfield, July 8, 19[illegible]

Plant 12, row ~~[illegible]~~ 10, has the largest of its nine berries turning [illegible] to-day.

Washington July 11, 1909

Culture 154. Forty cuttings from the Brooks bush, placed in the ordinary yellow sand of the propagating house by me to-day. The cuttings were made by me at Greenfield July 9, late after-noon, trimmed, the butts placed in a ball of wet sphag-num, and the whole wrapped tightly in paper. They were kept shaded and as cool as possible until placed in the propagating bed. In trimming the petioles were cut near the base. After placing in the bed the cuttings were covered with a large bell glass.

Culture 155. Twenty cuttings, Gould bush, put in white propagating sand to-day. Cuttings made July 9 in the late afternoon, not trimmed, placed in moist not wet sphagnum in a box, wrapped, put in the shade and kept as cool as possible till to-day. The cuttings were

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July 11, 1909

trimmed with a knife and placed in a 10-inch washed pot prepared as follows: crocks at the bottom, then about 1½ inches of fiber from kalmia peat, then about 4 inches of white glass sand. After the cuttings were put in and watered, the pot was covered with a window glass, and the whole kept shaded in the propagating house.

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Washington, July, [illegible]

Culture 153. The tallest plant measured to-day 480 mm. (19 inches) in height of stem.

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Washington July 13, 1909.

Culture 156. Twenty-six cuttings from the Brooks bush, made July 9, 1909, not trimmed, wrapped and treated till opened like the cuttings of Culture 154. To-day they were put in white propagating sand by Mr. Gages, in a pot, exactly ~~treated~~ like Culture 155, except that the leaves taken off were broken off, not cut off.

Culture 157. Twenty cuttings from the Stanley bush, taken July 9, trimmed, the butts placed in wet sphagnum, the whole wrapped tightly in paper and kept in cool shade till to-day, then placed in white glass sand in a pot like Culture 156.

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July 13, 1908.

Mite disease

A pathological phenomenon observed last summer on the aquarium plants has developed now on some of the window sill cultures. The leaves of growing shoots become semitranslucent or "watery" in appearance, remain small, develop a faintly rusty color on the lower surface, tend to become slightly cockled, and sometimes turn brown and wither. The shoots bearing such leaves evidently suffer from lack of nutrition.

It turns out upon examination to-day that these leaves are infested with a minute animal, probably a mite, much smaller than the red spider. The plants will be submitted to the entomologist for examination.

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[illegible]

[illegible] The [illegible] graft [illegible] made [illegible] from the [illegible] bud grow[illegible] [illegible] [illegible] [illegible] cm. in length. [illegible] [illegible] from the [illegible], 1.6 cm. long [illegible] made no new [illegible]. The [illegible] [illegible] continued [illegible] [illegible] [illegible] [illegible] bud, now [illegible] [illegible] cm. in length.

July 14, 1909.

There is as yet no ~~tendency~~ indication in any of the cultures, either of 1907 seedlings, 1908 seedlings, or cuttings, ~~to~~ of the differentiation of flowering buds, for next spring opening, on any of the new twigs or shoots of out door growth. This new growth is having a remarkable development, ~~some of~~ the new shoots known to have grown wholly since the plants were put in the cold frame, reaching as great a lengths as ~~being~~ 350 mm. ~~in length~~ (on the tallest plant of 153). ~~Very few~~ Some still longer shoots, 400 mm. in a plant of 89, probably developed during this period. Very few of these shoots and twigs have ~~ceased~~ withered their tips. Most of the ~~?~~ resting flowering buds that had developed ~~on~~ the plants while still in the greenhouse in the cool night temperatures of late winter have withered. Several such are noted to-day on Culture 43, on which only one flower is known to have been produced. An occasional plant of the '07 seedlings is still in flower.

Culture 153A. Tallest plant 470 mm high, except the tip recently withered.

Culture 153. Tallest plant 490 mm. high, tip withered.

[illegible]

[illegible]

Cutting #3 [illegible] has [illegible]
[illegible]
[illegible]
[illegible]
[illegible] flowered
[illegible]
[illegible]

Aug. 6. 190?

Culture 170. The ripe berries, several of them were picked from the bush to-day.

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July 17, 1909.

Mite disease.

Mr. Banks says that the mite recorded on the windowsill plants July 13, 1909, is a Tarsonemus, perhaps the same as the undescribed species found on seedling blueberries last winter. He will examine the animal and determine its identity.

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Latham, Mo., July 18, 189[illegible]

Vaccinium atrococcum although only [illegible] is still growing, has not as yet [illegible] any [illegible] buds [illegible] begin to make their buds. One shoot, from a stump made by cutting off a 3/4 inch stem last winter, has made a length this season of 36½ inches and is still growing, with several branches above. The shoot was [illegible] in [illegible]

The Kalmia leaves in [illegible]

[illegible]

July 17, 1909

Culture 154. The cuttings, which were a little dried, enough to wilt the young secondary leaves that had formed on some of them, on the morning of July 17, looks badly this morning. In probably more than half the cuttings the leaves are purpled on the [illegible]

Culture 150. One of the roots dug up to-day. Apparently still alive within, but [illegible] [illegible] [illegible] [illegible].

July 12 1918.

Window sill cultures. Moved down all the window sill cultures to the coldframes except 41A, 140, 145, and 143. ~~Bo~~

Culture 42. Brought up a plant of this number that had been in the coldframe, and earlier (during the winter) thought in spring in the greenhouse. It had produced in early spring four terminal racemes, the green pods of which are now approaching the ripening stage.

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July 20, '04

Culture 64. The six plants sent to T. N. Vail, Lyndon, Vt., to-day have the following height.

370 mm.
342
335
372
350
365

July 21, 1909

Culture 154. It turned out yesterday that the cuttings are being exposed to sunlight in early morning and late afternoon for two or three days I think. The sashes were therefore given a light coat of turpentine and white lead yesterday. It is probably that nearly all the cuttings will be ruined. The puckering noted earlier is increasing, there is some yellowing and the leaves are falling.

July 25, 1907

Culture 135. Twenty plants, repotted in 4-inch washed pots, crocks at bottom, then drainage cushion of coarse kalmia peat, then mixture of rubbed (1/4 inch sieve) kalmia peat 9 parts, glass sand 1 part, about half crocks between old ball and sides of pot. Plants in thumb pots (27) all alive, four however discarded as too small, the remainder 3 to 7 cm. high, [illegible] with about 15 to 25 leaves, the longer leaves reaching 5 cm. in length. Two plants taken out for specimens. One plant only was branched, others all growing from terminal bud.

Culture 134. All 35 plants alive, from 2.3 to 7.5 cm. high. Best plants around the outside of the flat. Leaves up to 5 cm. long

Culture 105. Four plants dead, one gone, 47 alive, two of these discarded. Remaining 45 1.5 to 4 cm. high, leaves about 12 to 20, up to 3 cm. long.

July 22

Culture 138. [illegible] [illegible], [illegible] in, very variable from 2.5–8 cm. long, leaves up to 1.5 cm.
Plants not so good on the average as [illegible].

Culture 37. Lot of 28 plants. [illegible] [illegible],
four were [illegible] as too small. Remainder 2.5 to 4 cm. long, leaves up to 4.5 cm. long. They are not average so good as 135.

July 23, 1937.

1937 seedlings in the frame measured to-day as follows:

Culture	–	584	mm
	73	633	"
	42	553	"
	8	540	"

1937 seedlings discarded to-day from the frame

Culture	70	40 ~~36~~	plants
	71	3	"
	42	4	plants (3 42 and 1 [illegible])
	27	2	"
	22	3	"
	21	1	"
	14	2	"
	9	1	"
	8	1	"
	6	1	"

July [illegible]

[illegible] 135A. Ten [illegible] taken out of [illegible] 135 and [illegible] 135A. The [illegible] [illegible] made pair by pair so that [illegible] of [illegible] [illegible] [illegible] in the two cultures. Culture 135 A is to be [illegible] with 1/10 per cent [illegible] of soda [illegible] after the roots have had a week to begin growth.

Culture 134A [illegible] taken out of culture 134 pair by pair so that the [illegible] cultures contained [illegible] of [illegible]. To be [illegible] [illegible] per cent [illegible] soon.

Culture 133. Four of the [illegible] those [illegible] are now making growth. Two of the four have made branches about 2.5 cm. long and ~~[illegible]~~ browned their tips

Lowham, Md. July 25, 19[illegible]

[illegible] seedlings of 1908 examined today. One (the northernmost one) dead. Others growing up to 40 cm in length.

[illegible] stamineum [illegible] up to [illegible]

[illegible] beginning to ripen. [illegible] seedlings [illegible]

[illegible] for [illegible] state.

[illegible] a bush found on the trail from Cooke's to Brown's with berries up to more than 16 mm. in diameter. A few of the largest berries picked from the bush measured as follows:

1 berry	16-17 mm.	Bush marked with a zinc tag.
1 "	15-16 "	
7 berries	14-15 "	
6 "	13-14 "	

July 26, 1908.

[illegible] [illegible]

Sown July 23 [illegible] by [illegible].

Soil [illegible] [illegible] (from [illegible] 35)

Sharp [illegible] sand 1

[illegible] sifted [illegible]

[illegible] [illegible] small [illegible].

Seeds from [illegible] field, July, 1908.

[illegible] 135. [illegible] July 23 [illegible] inch pots, [illegible], sandy, with [illegible] [illegible] between [illegible]. Twenty [illegible]

[illegible] 138. [illegible] July 23 [illegible] inch pots, [illegible] [illegible] [illegible], with [illegible] between [illegible] [illegible], 29 [illegible]

[illegible] 139. [illegible] July 24 [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible].

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WASHINGTON, D. C. July 26, 1907

Cultures 134 A, 135 A. Watered with 25 cc. each of a 1 to 1000 solution of nitrate of soda.

Same July 27.

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July 2[illegible] 19[illegible]

[illegible] 154 Fourteen cuttings blackened, re-moved today. Of the remaining 11 have lost their leaves, 14 have still one or more leaves.

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July 28 19[illegible]

Culture 89A One of the plants has reached a height of 530 mm. the tallest ~~of the~~ of the 1708 seedlings. The plant however is drawn from growing in the shade and is affected with the mite.

~~Culture 134 A~~

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July ~~28~~, 1909.

Culture 157 Sixteen cuttings of Leucothoe racemosa, from the lower edge of the Scofield-Collins woods at Lanham. Made this morning. Placed in the blueberry cutting bed. The plant is now sending out its racemes for next years flowering.

Culture 64. Twenty-five plants taken out of the cold frame to-day and repotted in six inch pots in peat 2, sand 1. with [illegible]. The height of the plants is as follows

375 mm.	340	275
350	310	345
310	270	350
355	280	320
330	310	~~[illegible]~~
275	405	
350	350	
295	365	
355	220	
365	375	
305		

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July 28, 1909.

Culture 159. *Gaylussacia dumosa*. Seeds ~~planted~~ sowed to-day in a flat with a layer of coarse kalmia peat at the bottom and a mixture of 5 parts glass sand and 6 parts ~~by bulk~~ finely sifted kalmia peat, by bulk. Collected at Lanham July 25.

Culture 160. *Vaccinium atrococcum*. Seeds sowed to-day, collected at Lanham July 25, same flat and soil as 159.

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WASHINGTON, D. C.

July 29, 1909.

Culture 161. Rhododendron maximum. Seeds from Beadle, Biltmore, received last winter, sowed to-day in a flat with coarse kalmia peat drainage below and a soil of finely sifted kalmia peat 2 parts, glass sand 1 part.

Culture 162. Leucothoe catesbaei. Seeds from Beadle, Biltmore, last winter, sowed to-day like Culture 161, same flat.

Culture 163. Azalea lutea. Seeds from Beadle, Biltmore, last winter, sowed to-day like Culture 161, same flat.

Culture 164. Leucothoe racemosa. Seeds from Beadle Biltmore, last winter, sowed to-day like Culture 161, same flat.

[illegible]

[illegible] Sup [illegible] [illegible]

Cutting [illegible] [illegible]

Cust[illegible] [illegible] but the [illegible]

in general part.

[illegible] [illegible] [illegible],

July 1, Max. [illegible]°

20 Min. 73°

July [illegible] Max. [illegible]5°

[illegible] Min. [illegible]

Cutting 165 [illegible]

[illegible]

Cutting 166. [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

cut

Cutting 168. [illegible]

[illegible]

[illegible] 10-17 mm

[illegible]

[illegible]

[illegible]

[illegible]

Cutting [illegible]. [illegible] winter

cut off, leaving only the two grafted

branches, ~~these~~. 10 and [illegible] mm. long.

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TAXONOMIC AND RANGE INVESTIGATIONS.
Washington, D. C.,

Linville, N.C. Aug. 7, 1909.

"Wild gooseberry". Polycodium

Sometimes made into preserves, not poisonous.

"Huckleberry", in particular "blue huckleberry". Vaccinium pallidum

"Hog huckleberry". Gaylussacia, apparently G. baccata.

Unknown

August 7, 1909

Culture 169. Sixteen cuttings placed in the north frame cutting bed yesterday by . These are from the Grandmother bush

Culture 170. Twelve cuttings, Grandfather bush. Set in the north cutting bed today by myself.

August 9, 19[illegible]

Culture 154. All but 17 cuttings have lost their leaves, [illegible] (from the base up) [illegible] [illegible]. Of [illegible] eight still retain one or more leaves, six are leafless and green above ground. The contamination, except in the case of very soft wood, comes from the cut surface of the cutting and works upward, the part above the surface of the sand remaining green till all below is blackened.

The six leafless cuttings are [illegible] up and removed today. All were blackening from the base upward.

Culture 158. Leucothoe. Has lost no leaves as yet. All look in good shape.

Culture 165 Cornus mariana. All [illegible] [illegible]. Most of the wood appears to have dried up. Five cuttings left [illegible].

Culture 166. Polypodium. Some leaves browning in base, but [illegible] staying on.

Culture 167. Leaves beginning to fall. Two cuttings [illegible] tips turning brown [illegible] removed. [illegible]

[illegible]

Polycodium. August 9, 1909.

Culture [illegible]. Leaves nearly all blackened and fallen

Culture 155. The wood of these cuttings ~~[illegible]~~ is deeper and has a somewhat withered look. One cutting [illegible] [illegible] was blackening from the flame to the surface but [illegible] not yet [illegible] the leaves

Cultures [illegible] A, 155A. Each pot given 250 cc 5% solution nitrate of soda.

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Aug. 9

Polygonatum melanocarpum (Drayton no 3)

Berry 1 mature seeds 24
2 " " 28
3 " " 35.

August 10, 1909

Culture 171. Polycodium Crayton no 1.
Six root-stem cuttings, placed in the
propagating frame to-day.

Culture 172. Polycodium Crayton no 1.
Eight twig cuttings, placed in the
propagating frame to-day.

Culture 173. Polycodium Crayton no 2.
Five root-stem cuttings, placed
in the propagating frame to-day

Culture 174. Polycodium Crayton no 3.
Six root-stem cuttings placed in
the propagating frame to-day.

Culture 176. Dendrium [illegible]
from [illegible] Mass. [illegible]
Aug. 6 1909. Three small rooted plants,
potted in Sphagnum peat 9, sand 1, in 4
5, & 6 in pots

Culture 177 Dendrium prostratum. from
[illegible] 1909. To
potted Aug. [illegible]
5 inch pots.

[illegible] 1917.

[illegible] 73

[illegible]

Out [illegible] min. 96 ~~2~~6 [illegible]

max. 77 [illegible]

August 10, 1909.

Culture 77. Five plants, of the following height

50 mm.
53 "
48 "
46 "
26 "

Culture 79. Three dead, two alive besides check
Check 80 mm.
Others 30 "
30 "

Culture 73.
225 mm.
160 "
230 "
245 "
285 "
230 "

Culture 74. None alive.

Culture 75.
263
155
210

Culture 75 A
368
295
215 variegated
220 pinched back once

Aug 9, 1908

Culture 76

245 mm

70 "

203 "

Culture 77A

~~7~~ 163 mm.

Culture 78

215 mm. Peat water Apr. 7, 11, 19, 29 etc.

Culture 78 Two smallest

70 mm.

80 mm.

Culture 80

235

310

155

240

215

August 18, 19[illegible]

[illegible]

Maximum height (leaves and all) in seedlings of 1908, as follows:

[illegible] 55	550	mm.	(growing)
	570	"	"
47	544	mm.	(stopped)
47	565	mm.	(growing)
47A	530	mm.	(stopped)
43 A_2	515	"	(growing)
153	520	"	(growing)
55B	525	"	"
55 B.	545	"	"
[illegible] A	640	"	[illegible]
56 A	505	"	(growing)
127	615	"	(stopped)
43	See other sheet of this date		

August 10 [illegible]

Culture 43, Manure in the [illegible] as follows.
[illegible]

M	B1	475 mm.	
	[illegible]	[illegible] "	Manure water applied
	[illegible]	[illegible] "	[illegible], 25, 29, [illegible] 6, [illegible] 24
M	F4	350 "	
	D	3[illegible] "	
M	[illegible]	520 "	
	B3	340 "	a little brown
M	C[illegible]	573 "	brown above, [illegible] in [illegible]
M	[illegible]	[illegible] "	" " " " "
	B4	405	
M	A3	543 "	brown above
	B5	375	

[illegible] Average height manure [illegible] 5[illegible] mm

A3	543
C[illegible]	573
F[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	520
	[illegible]
	[illegible]

[illegible] Average height [illegible] [illegible] 422 mm

B4	405
B5	375
A1	[illegible]
B3	340
B5	447
M5	[illegible]
	[illegible]

Rhododendron peat from T. R. I.
[illegible]
[illegible] 1.6

Aug. 12, 1909.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

August [illegible]

Culture 17 A. This is the mark given to a plant of Culture 17, which in the cold frame, plunged in sphagnum, has ripened berries up to a diameter of $12\frac{66}{100}$ mm. The plant has been brought up to the window sill and the pot placed in a larger pot with sand [illegible].

[illegible]

[illegible] by Mr [illegible]

Culture 181. A [illegible] of [illegible] (Culture 3)
[illegible] growing by Mr. Boyle [illegible]
from the Bromide bath. The [illegible]
[illegible] sphagnum in [illegible]

Culture 172. [illegible] Culture [illegible] growing
by Mr. Boyle with 1 Bromide [illegible]

Culture 1[illegible]. A [illegible]
[illegible] grown by by Boyle with 1 Bromide bath
[illegible].

Culture [illegible]. A [illegible]
by Boyle
growing [illegible] 1 Bromide bath [illegible]

Culture [illegible] A [illegible] [illegible] growing
by Boyle with 1 Bromide [illegible]. Plunged in
sphagnum [illegible] Boyle [illegible].

Culture 1[illegible] A [illegible] Culture [illegible] growing
by Boyle with 2 Bromide baths. Plunged
[illegible] in a [illegible].

Culture 167 A [illegible] Culture [illegible] growing
by Boyle with 2 Bromide baths [illegible]. Plunged
in sphagnum [illegible].

4187

26) 10361 (395
78
246
234
121
130
17

Average height 395 mm

435
448
400
350
140
402
10361
45
2807
7371
7371
11171

26) 11171 (429
104
77
52
251
234
17

Average height 430 mm

August 17, 190[illegible]

Culture [illegible] Measured [illegible], leaves and all, as follows:

207	422	305	
480	66[illegible]	125	
687	240	316	
	330	410	
	475	435	
	347	5[illegible]	[illegible]
	360	445	3[illegible]
	270	480	320
	368	445	420
	465	310	370
	385	578	4[illegible]
	5041	9468	11798

$3.0 \overline{)1179.8}$ = 393

Average height 393 mm.

after measuring, 2 small plants thrown out.

Culture [illegible] Measured [illegible] as follows:

420	475	
370	330	
230	405	
430	425	
140	440	
1610	425	
	460	5880
	420	195
	365	348
	270	345
	215	325
	5880	7093

$2.0 \overline{)709.3}$ = 355

Or, with Culture 153 (see Aug. 16)

26) 9,925 (382

Average height 355 mm. or in conjunction with 153, 382 mm.

After measuring six small plants thrown out.

Culture [illegible] B, Measured today, leaves and all, as follows:

[illegible]	[illegible]	
[illegible]	[illegible]	
435	420	
4[illegible]	520	
530	345	
505	410	
45[illegible]	575	
3088	493	
	360	7721
	410	375
	375	350
	7721	8446

$2.0 \overline{)844.6}$ = 422

Average height 422 mm.

Culture 178. [illegible]

[illegible]

[illegible] The cuttings [illegible]

not [illegible]

[illegible] Each plant [illegible] 25 cc.

[illegible]

August 16, 1909

Culture 153. Plants measured to-day as follows:

465
565
500
512
450
340

6)2832
472 mm average.

Culture 188. A plant of Culture ~~67~~ 70, seedling of 1907, budded to-day by Boyle with a bud from a cutting taken from Culture 169, Vaccinium pallidum

Culture 189. A plant of Culture 6, seedling of 1907, budded to-day by Boyle with a bud from a cutting taken from Culture 169, Vaccinium pallidum.

(error) Culture 169, Vaccinium pallidum

Culture 190. A plant of Culture ~~70~~ 17, seedling of 1907, budded to-day by Boyle with ~~two~~ one bud from a leafless cutting taken from Culture 170, Vaccinium pallidum.

Culture 191. A plant of Culture 6, seedling of 1907, budded to-day by Boyle with two buds from a leafless cutting taken from Culture 170, Vaccinium pallidum

Cultiv. [illegible] A plant of Cultiv. 7, [illegible] spring of 1907, budded [illegible] by Boyle [illegible] from a cutting of [illegible] Maximum Califor-

Cultiv. 67 E. A [illegible] 42 [illegible] [illegible] middle of 1907, budded [illegible] by Boyle [illegible] bud taken from a cutting of Cultiv. 67 Maximum Californicum.

August 17, 1950.

Culture [illegible] One plant 630 mm. long leaves

Culture [illegible] and all [illegible] 640 [illegible]

Culture 56A Plants measured [illegible] leaves and

all [illegible]

	2150	5545	9565	13955
	470	335	[illegible]	455
	3[illegible]	370	350	[illegible]
	[illegible]	390	380	3[illegible]
	340	275	475	4[illegible]
	460	300	510	([illegible])
370	([illegible])	425	430	~~[illegible]~~
345	315	500	420	15625
375	355	465	250	
220	325	[illegible]	510	
475	400	[illegible]	320	
350	375	415	450	
2150	5545	9565	13955	

Culture 56. [illegible] measured [illegible]

	2135	6565	10915
	360	420	380
	345	400	400
	390	315	420
	410	365	~~[illegible]~~
	~~[illegible]~~		
	315	445	410
337	475	175	430 [illegible]
363	385	450	375
[illegible]5	4[illegible]5	525	500
425	515	415	15830
220	390	460	
395	425	300	
2135	6565	10915	

Aug. 7, '07.

Culture 192. About 24 root-[illegible] cuttings of ~~[illegible]~~ Polycodium melanocarpum [illegible] (Coville's No. 3) [illegible] in the cutting bed by Mr. Gages ~~[illegible]~~ today; in the propagating house.

Aug. 18, '07.

Culture 103A. Ten plants [illegible] taken out [illegible] and numbered 103 A.

Culture 55A. Ten plants taken out of Culture 55, four by [illegible], to be [illegible] the same except [illegible] [illegible] nitrate of soda. Each [illegible] 25 cc [illegible]

Culture 156. Now 14 cuttings, nearly all callused, transferred to propagating [illegible] bed today by Mr. Gages. Bell glass.

Culture 155. Now 10 cuttings, ~~all~~ callused, transferred to propagating cutting bed today by Mr. Gages. Bell glass.

Culture 157. Now 10 cuttings, all callused, transferred to propagating bed today by Mr. Gages. Bell glass. One rooted cutting potted as 157A.

August 8,

of Mosses, Ferns and etc.

435 mm.	3450	12) 4535 (386
360	455	36
370	~~300~~ 420	103
375	330	96
405	335	75
465	410	12) 4801
	385	400
	4805	

Average height
~~386~~
400 mm.

Meas

390 mm.	2455
370	360
385	375
455	405
360	405
535	360
	420
	~~4770~~

~~12) 4770~~
~~409~~

Average height
~~409~~
395 mm.

36
114
108
6

315

[illegible] 3. Cutting [illegible]
[illegible]
[illegible] 3, [illegible]
[illegible]
[illegible] Sinclair [illegible]
[illegible]
[illegible]
[illegible]
[illegible] 1856. [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible] 1884 [illegible]
[illegible]
[illegible]

Aug. 8

[illegible] game

yesterday

[illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

August 18, 1909

Sodium nitrate used on over-low cell cultures. Two liter bottles filled as follows: July 31

Aug 5

Aug 8

10

12

17. bottle filled [illegible]

Applications discontinued to-day.

[illegible], 2-liter bottles as follows: Aug 2

8

12

August 19, 1909

~~Portland, Or.~~

~~Sept. [illegible]~~

Mr. M. M. Gorman told me at Portland, Or. on Sept 17, 1908

at his old home at [illegible], Penn [illegible]

[illegible] County, Indiana, some species

of low blueberry grew and

fruited in abundance on [illegible]

stone rock. Write to [illegible]

P. Gorman [illegible] for specimens

August 19, 1917

[illegible] [illegible] about [illegible] [illegible] germinated. The seeds were sowed about July 14, 1917 from [illegible] [illegible] [illegible] [illegible].

[illegible]

Lanham, Aug. 20, 1909.

The wild plants of *Vaccinium atrococcum* have begun to form their flowering buds for 1910. They do this through a growth development from the ordinary leaf buds already formed in the axils of the upper leaves of the twigs. The two sharp scales of these ordinary buds, on this plant already turned brown, are pushed apart by the growing tissue and the many scaled fat bud containing the flower buds proceeds to develop, the two original scales remaining on the outside of the bud. Specimens collected.

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY.

TAXONOMIC AND RANGE INVESTIGATIONS.

Washington, D. C.,

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

August [illegible], '07.

Wild seedlings, probably of *Vaccinium atrococcum*, in sandy moist mossy soil on a north slope, by a spring near Lanham, Md. The spring is on the east side of the Pennsylvania railroad south of Lanham station, on the west facing hillslope on the east side of a wooded ravine draining to the south.

The small seedlings, of which 33 are preserved, grew in one tuft not over an inch in diameter. In most of them the cotyledons are brown, in a few still green. The plants bear from 3 to 8 leaves above the cotyledons, almost all of them still green. The axis is in no case branched. The plants vary in height from 1 to 2.5 cm. They are evidently from seeds that germinated last spring.

Of the 4 older branched seedlings, 7 to 9 cm. high, one, bearing the dead stem of the first year, is clearly at the end of its second year. The others may be third year seedlings.

These seedlings grew intermixed with a lot of [illegible] *Ligustrum*, but they are believed from their pubescence to be those of *Vaccinium atrococcum*.

August [illegible] 1899

[illegible] 176. [illegible]. The [illegible] [illegible],
[illegible] and growing [illegible] [illegible]
partially lying, the other [illegible] [illegible].
[illegible] Both doing well.

[illegible] [illegible]. Cutting all [illegible] [illegible]
[illegible]. Nine [illegible] of [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
at [illegible] [illegible] bud only the base [illegible]
[illegible] brownish. These [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] ~~[illegible]~~
[illegible] alone. Many [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] and [illegible] [illegible] [illegible] [illegible]
the [illegible] having [illegible] [illegible]

[illegible] 183. [illegible] in good condition.
[illegible] 186. [illegible] [illegible] [illegible] [illegible]
[illegible]. Bud alive.
187. Bud alive
[illegible]. [illegible]
[illegible] [illegible]
[illegible]. [illegible] [illegible] [illegible]
187. [illegible] bud [illegible] alive, [illegible] [illegible] [illegible] [illegible].
181. Bud alive
182. Bud alive ~~[illegible]~~, bud [illegible] [illegible] [illegible] [illegible].

August 24

Cutting [illegible] ~~ground~~ plump, ~~[illegible]~~ [illegible] swelling [illegible] [illegible] lie. [illegible] [illegible] off by Doyle and died.

[illegible] 27. Bud plump.

Aug. 23, 1909.

Culture 193. Vaccinium pallidum. From mother bush. Seeds sowed in a small flat in kalmia peat 7, glass sand 2, sifted sphagnum 2.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

48

(Counted as 5)

53

August 25, 1909.

Smithsonian bushes. ~~South~~ North bush just beginning to expand its flowering buds for 1910, south bush not yet begun.

Culture S.B. [illegible] [illegible] 1.00 planted to [illegible] [illegible] two stems [illegible] [illegible] [illegible] large, vigorously [illegible] [illegible] [illegible]

Can it be forced to [illegible] [illegible] growth?

Temperature of propagating frame

Time 4:30 P.M.

Propagating frame 68° F.

Outside propagating frame 56°

Pennsylvania Avenue
[illegible] kiosk 100°

This was a hot day after several days of much cooler weather.

August [illegible] 1907

Culture [illegible] Berry — this plant ~~[illegible]~~ is purple to day

Culture 55 B. Largest plant 650 mm. [illegible] long [illegible] [illegible] approx. 623 mm.; still growing

Cultures [illegible]. The [illegible] ~~[illegible]~~ showed a [illegible] injury on the [illegible] [illegible] 23 [illegible] [illegible] [illegible]

[illegible]

Cultures 155, 56, 57. These showed [illegible] [illegible] [illegible] [illegible] [illegible] and [illegible] [illegible] many [illegible] [illegible] [illegible] [illegible] wound.

[illegible] The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] pit.

[illegible]

Culture [illegible]

[illegible]

[illegible]

Cultivars 167 [illegible]

[illegible]

[illegible] [illegible] 1-16 [illegible]

[illegible]

[illegible] [illegible] [illegible]

[illegible] above, the others are

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] 171 [illegible]

[illegible]

[illegible]

[illegible] Two [illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible]
[illegible]

[illegible] [illegible] [illegible]
[illegible] more [illegible]
[illegible]

[illegible]

[illegible] Now laying down flowering
buds for 1910 [illegible] profits.

Cutting [illegible] twelve pots, those at the front
of the [illegible] [illegible] back [illegible] the
[illegible] [illegible], to see whether
these plants will not lay down more
flowering buds than the average of plants
[illegible] [illegible]. The twelve plants are

D4 F1 J5 L4 N2 P2
D5 G4 I1 L5 N3 P1

30

43

157

120

[illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

OFFICE OF
TAXONOMIC INVESTIGATIONS.

Soil solutions of equal acidity.

Peat 100 cc.   Sand 100 cc.

25 gr. 100% water	125 gr. 10% water
25 cc soil solution	12.5 cc soil solution

Therefore if the soil solutions are of equal acidity a sand soil will hold only one half as much acid as an equal weight of peat soil, and one half as much acid as an equal bulk of peat.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

OFFICE OF
TAXONOMIC INVESTIGATIONS.

Experiments with 1907 seedlings.

After ripening wood and cleaning ledges outdoors
Repot in 4 inch pots in ~~[illegible]~~ leaf ~~peat~~ ~~[illegible]~~ as follows.

Culture 6
7 —
8 wash out soil
9 " " "
11
12 wash out soil thoroughly.
13 " " " "
14 —
17
19
20 wash soil out thoroughly
21 " " " "
22
27 wash soil out thoroughly.
2a

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Culture 105 February 15, 1909, peat 6, leafmold, sand 1, loam 1.
134. March ~~25~~, 1909, peat 8, sand 1, loam 1.
135 March 26, 1909, " " "
138 April 5, 1909, pure kalmia peat
139 April 6, 1909, " " "

Cultures 105. Repot, 4-inch pots, peat 9, sand 1.
134 Repot, 4-inch pots, peat 9, sand 1
134A Half the plants of 134, equal in structure with those remaining in 134, to be watered with nitrate of soda solution

Culture 108 Feb. 18 Peat 8, sand 1, loam 1

" 18 109 Peat 5, leaf mold 3, sand 1, loam 1

" 19 110 Peat 3, leaf mold 5, sand 1, loam 1

" 19 110A Peat 2½, leaf mold 3¾, sand 2, loam 1

Feb 20 111 Leaf mold 8, sand 1, loam 1

" " 111A Leaf mold 6, sand 3, loam 1

Culture 55 Peat 8, sand 1, loam 1

55A Peat 7, [illegible] 1, [illegible] 1, loam 1

55B Peat 10

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WASHINGTON, D. C.

Sand without nutrient, tap water
" without nutrient, peat water
" without nutrient, humic acid
" with nutrient, acid
" with nutrient, alkline
Peat 8, sand 1, loam 1
Peat 7, manure, sand 1, loam 1

Bench space

South end,	1 ft. 10 1/2 in.	x 2 ft. 6 in.
	1 ft. 11 in.	x 2 ft. 5 in.
West side,	13 ft. 7 in.	x 2 ft. 9 in.
	1 ft. 3 in.	x 2 ft. 5 in.
East side,	24 ft. 1 in.	x 2 ft. 9 1/2 in.
	1 ft. 3 in.	x 2 ft. 6 in.

Repeat in 6 in in feets, pure peat,

43

Repeat in 6 in 1 feets

47 peat 6, sand 1, loam 1

47A " " "

55 " " "

55A peat 7, manure 1, sand 1, loam 1

55B pure peat

BPI

7266

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Kingston [illegible] [illegible]

[illegible] 45 [illegible] [illegible] in 1899

These were [illegible] plants. [illegible] about
2 mo[illegible] [illegible] and [illegible]
[illegible] by [illegible]
[illegible]

S. C. [illegible], assistant agronomist.

[illegible] Card cuttings were [illegible] over to him. Schermerhorn says that [illegible] [illegible]

[illegible] that [illegible]
[illegible] cuttings [illegible] [illegible] years.

People [illegible] [illegible]
[illegible] Mr. [illegible] says [illegible]

because they do not grow large [illegible] [illegible]
[illegible] 1117 [illegible]

Hingham Mass Aug. 26 [illegible]

Blueberry plants grafted by Edmund Hesey ~~more than 19 years ago, probably~~ 25 years ago. Now 6 feet high, with stems up to 2 inches in diameter. Mrs. Hesey believes they were grafted near the surface of the ground. The bushes have borne berries up to the present time. They are now considerably injured by [illegible] of some neighboring [illegible]

[illegible] published in [illegible] Ploughman of which [illegible] 20 [illegible]

[illegible]

Look up article entitled "The Highbush Huckleberry", published in the Massachusetts Ploughman about June or July, 1884. This [illegible] [illegible], [illegible] his successful grafts, [illegible] in the following year. Also "The Huckleberry Crop", same journal August (next year?)

Also "Improving the highbush huckleberry", same journal apparently May 19, 1882

Also "The huckleberry crop", same journal, editorial, apparently date August probably same year.

Also "Growing the blueberry", same journal, apparently early in 1880. Refers to earlier articles in the same journal, and the newspaper [illegible] that followed.

Also "The blueberry", same journal about June or July, 1880.

Also "Swamp blueberry", same journal, about February, 1881. E. D. [illegible] writing from [illegible], Mass., tells of a high bush blueberry in his pasture with berries 1½ in. in circumference

[illegible] August [illegible] 1909.

Wild bushes of [illegible] corymbosum ~~[illegible]~~ ~~[illegible]~~ lay down their flowering buds for next year. [illegible]

[illegible]

[illegible]

pennsylvanicum & Canadense

The bushes of [illegible] [illegible]

[illegible]

[illegible] same bushes.

On the [illegible] of [illegible] plants layered early in July, 1909, new [illegible] pennsylvanicum have grown [illegible] of [illegible] height of about [illegible] cm. The majority are still growing though some have recently [illegible] their [illegible]. It is [illegible] whether these [illegible] will lay down flowering buds.

Greenfield, [illegible]

Orchard bush. This bush, which was been overlooked by the children [illegible] for is loaded with [illegible] berries. One branch 25 cm. long, much branched, the twigs spreading [illegible] 22 cm. has 108 plump berries and 17 partly [illegible], no [illegible]. [illegible] of the berries are slightly in excess of 11 mm. diameter. All are dull [illegible]. It is *Vaccinium macro-num*. The 108 *berries* [illegible] [illegible]. The branch is [illegible] mm. in diameter, and is 8 years old. The new growth twigs ~~[illegible]~~ [illegible] up to 5 cm., mostly 1.5 to [illegible]

Cabot and I picked a little [illegible] 2½ quarts of the [illegible] the berries [illegible] mm. though [illegible]

Greenfield, N. H., Aug. 30, 1909

Brooks bush. Sent budwood to-day to [illegible] and about 15 cuttings to Oliver.

Buds for ~~1909~~ 1910 flowering beginning to be laid down.

Budded with a Brooks bush bud a ~~twig~~ branch on a small bush about 4 feet high, with a little 4 foot pine tree in its middle. Bud tied in with brown cord and the branch marked with a white rag.

Took budwood for grafting on the farm.

Budded with 1 bud each, three blueberry bushes on my own farm (a) the big bush by the alders, north of the swamp, (b) the bush east of the Cabot bush on the road to the orchard field, (c) the Cabot bush itself. Each was grafted on wood grown in 1908. Most of the plants would not peel. The few that would, peeled most easily on the north side of the twig where the bark was still green, not yet having begun to develop its cork layer and split its epidermis. ~~The~~ The buds were all from the Cabot bush.

Wareham, Mass., Aug. [illegible]

Visited the cranberry bog and screening house of Mr. John M. Bridge about 1 mile south of Wareham on the road to New Bedford. Also talked with Mr. J. C. Makepeace.

Largest berry seen 17-19 mm, ordinary large ones 13-14 mm.

Barrel before screening commonly contains about a hundred pounds. Barrel commonly regarded as about three bushels.

Price commonly $6.00 per barrel.

Pickers by the day get 30 to 35 cents per hour. Pick about a bushel per hour, with a rake.

Day short, from dew to dew, about seven hours. On cool [illegible] days [illegible] vines often begin to wilt by five o'clock. Berries must be under cover at end of day.

Forty barrels per acre a good crop according to Mr. Makepeace, sometimes 100 or even 120.

Picking begun August 25 on some bogs.

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[illegible] Mass., Sept. [illegible] 1909

Visited Wankinco cranberry bogs with Mr. J. C. Makepeace, ~~[illegible]~~ about six miles north of Wareham.

Made a soil section in a bog that had been in cranberries about 20 years.

Soil 1. Sand about 5 inches, the upper half of it [illegible] in [illegible] [illegible] [illegible] [illegible] the [illegible] [illegible] [illegible] brown [illegible] [illegible] [illegible] [illegible] [illegible]. This layer full of roots.

Soil 2. Fibrous peat loose and very cracked, full of roots, about 2 inches.

Soil 3. Black peat, fairly [illegible], with abundant root formation in the cracks. This about 10 inches deep.

Soil 4. Soft black peat, full of water, about 20 inches. This contains very few roots all brown and [illegible]. There are no cracks.

This year about 25 to 30 [illegible] per acre the crop promises to be.

Flood from [illegible] to May or early June, some of the [illegible] [illegible] [illegible] [illegible] feet under

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Wareham, Mass., Sept. 1, 1909

Turfing ax, B[illegible] + Sons, [illegible]
[illegible], tool.
or
Hauler. Bought one of [illegible], South Carver, Mass. $1[illegible]

"Barrel to the square rod" is the cranberry mans ideal of a maximum crop. Mr. Makepeace showed me a patch of [illegible] berries that he thought would go a hun- [illegible] barrels [illegible] [illegible] [illegible] this year. Drainage [illegible] about 2½ feet wide by 2 feet deep.

Best cranberry lands characterized by an original growth of "brown brush", Chamaedaphne calyculata. The root mat of this ~~being~~ having been taken off there remains, in the area examined, about 3 or 4 inches of fibrous peat, then the [illegible] peat.

Sulphate of iron killed fern and bidens, did not injure cranberry.

[illegible] all-round fertilizer used on most of the [illegible], no manure.

[illegible] [illegible] [illegible].

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Wareham, Mass., Sept. 1, 1909.

One of the Makepeace's men once picked a hundred bushels in an eight hour day.

Costs $400 to 500 an acre to buy and put land into cranberries.

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Mr. Pey[illegible]   [illegible]areham, Mass. Sept. 2, 19[illegible]

Cranberry preparation

$300 to $350 for making an acre of wild bog into cranberry bog, including ditching, draining, planting and everything.

Cost of land $40 to $[illegible] per acre.

Good cranberry bog worth about $1000 per acre.

Dodge's bog.

Measure holds six quarts. Get 5 cents, hand-picked, 7 cents with "snapper" or "snapping machine".

Mr. [illegible]. Cost on his bog $150 for [illegible] [illegible] turf and sanding, instead of $[illegible] an acre.

Once a neighbor used [illegible] [illegible] 3-year-old turf [illegible] [illegible] one place in a bog, [illegible] ~~[illegible]~~ [illegible] vines [illegible] of excellent quality and more [illegible] than he ever saw before, but the berries did not keep.

Ditches 2 feet deep, [illegible] feet wide at bottom, 3 feet wide at top.

Fourteen measures per [illegible] barrel, a hundred quarts per packed barrel.

[illegible] sand [illegible] last year, light sanding.

Wareham, Mass., Sept. 2, 1909

Area about to ~~now~~ ~~being~~ utilized for a cranberry bog. Vegetation as follows, in the order of abundance.

Clethra

Gaylussacia baccata

Chamaedaphne calyculata

Kalmia angustifolia

Vaccinium corymbosum

Myrica cerifera

Azalea

Gaylussacia dumosa

" frondosa

Ilex ?

Acer rubrum

Pinus strobus

"Scoop", like a large blueberry rake with teeth more than half an inch in diameter, said to be used only on old bushes that need replacing. It tears the bushes up badly.

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Wareham [illegible]

[illegible] [illegible] an acre in some

cases. First [illegible] years [illegible]

[illegible] $[illegible] an acre, but should [illegible]

sell [illegible] cost.

Next [illegible] to commence next

Monday, Sept. 7.

[illegible] may be coarse or fine. [illegible]

[illegible]

[illegible]. [illegible] but it [illegible] means

[illegible] and [illegible] mean heavy

expense [illegible]

"Swamp huckleberry, or high-bush blue.

[illegible] roots [illegible]

[illegible] the [illegible]

grow and [illegible] under the cultivation [illegible]

[illegible] cranberries, even [illegible] submerged

[illegible] water from December to May [illegible]

[illegible]

Wareham, Mass, Sept. [illegible].

N. A. Cobb, Chicago.

Tunnel City, Wisconsin, important shipping point

Wisc. + Minn. Chicago Mil + St Paul will give stations

Mich. Moseley Bros, Grand Rapids, will give shipping points. Carpenter Cook Co, Menominee and Marquette.

For Chicago market Butler, Homan + Co, Chicago, for blueberry market. Also C. T. Lowe + Co, refer to Mr. Cobb.

Very large Wisconsin cranberry, Metallic Bell

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Washington, D. C.
TAXONOMIC AND RANGE INVESTIGATIONS.

Wareham, Mass., Sept. 2, 1909.
C. C. Latham, Groton, Mass.
Cooking cranberries
Two quarts berries
One quart water, poured over berries
Two and a half
Half pint cups of sugar, poured over berries
when they begin to boil
boil ten minutes, [illegible].

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TAXONOMIC AND RANGE INVESTIGATIONS.
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UNITED STATES DEPARTMENT OF AGRICULTURE,
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Concord Mass., Sept. 3, 1909.

Charles W. Prescott. About 3 acres of open leatherleaf bog, about 50 acres of peat bog, mostly maple bottom.

Budded 5 bushes of Vaccinium corymbosum, one bud each.

Area lined with blueberries.

Took three samples of soil from the leatherleaf bog, labeled as follows

Concord 1. From first six inches, brown, filled with dead stems and other remains of leather leaf.

Concord 2. About four inches, nearly black, filled with live fine roots of the leatherleaf, soil rather granular.

Concord 3. Unmeasured depth, nearly black, with many cracks, and few live roots of leather leaf.

Samples sent to Washington.

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Boston, Mass., Sept. 4, 1909.

Bought of a street dealer in fruits a box of fine-looking blueberries for 20¢.

The box contained a leaf of *Vaccinium canadense* and one of *Vaccinium pennsylvanicum*. The berries were light blue and plump and fairly clean. Out of the box were selected sixteen berries ~~larger~~ more than 12 mm. in diameter. Of these, 12 were 12-13 mm. berries, ~~four~~ and 4 13-14 mm.

A handful of the berries after these 16 had been taken out ran as follows:

7-8 mm	4	berries
8-9 "	24	"
9-10 "	16	"
10-11 "	14	"
11-12 "	3	"

Some of the berries may be *Vaccinium corymbosum*.

Boston, Sept. 4, 1909 1

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Boston Produce Market Report

Blueberries.

1908	Mass & N.H.	New Brunswick	Nova Scotia	
July 28 (Tuesday)	9-12		12-14	"Blueberries easier with majority selling for the most part at 9-11."
30	7-10		9-11	"Blueberries have been coming more plentifully and this noon the market is somewhat stuck on same, and prices have materially weakened"
31	7-10		9-1[illegible]	"Blueberries continue to move slowly with plenty offering at yesterdays quotations, and considerable stock too poor in condition to bring even these figures"
Aug. 3 Monday	6-8	6-8	8-10	"Blueberries are in full supply and low with a sticky market prevailing"
4	6-8	6-8	8-10	Ditto same
6	7-9	8-12	8-12	"Receipts of blueberries were heavy during the past week and very low prices ruled. Less stock however offers to-day and the market is doing better".
7	"	"	"	"Blueberries remain as last quoted, with native stock pretty well run out."
10 (monday)	8-10	9-12	9-12	"Blueberries when fancy bring good prices, but most stock running too poor to be classed as such."
11	"	"	"	"Ditto"
13	"	"	"	"Blueberries hold their own with sufficient receipts to supply all demands".
14	8-10	6-8	8-12	"New Brunswick blueberries arriving mostly poor and bring small prices"
17 (monday)	8-10	6-8	8-12	"Blueberries continue to string out and have a steadily [illegible] trade"

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1908 (con)

	Mass. & N.H.	N. Brunswick	Nova Scotia	
Aug. 18	6-7	5-7	6-8	With very heavy receipts for the past few days the blueberry market yesterday and today was very weak and prices quoted are practically all that could be obtained.
20	6-8	7-8	8-10	"Blueberries are recovering somewhat from their slump of the first of the week".
21	"	"	"	"Blueberries continue to arrive and sell at quotations".
24 (Monday)	"	"	"	"Blueberries are hard to place and remain as last quoted".
25	6-8	5-7	6-9	"Blueberries in large supply and move slowly at low figures".
27	"	"	"	"Blueberries continue to move at unchanged quotations and offer in good supply".
28	6-8	6-8	8-10	"Blueberries offer in smaller supply and are firmer".
31 (Monday)		6-9	8-11	"The blueberry market is better and firmer returns are being realized.
Sept. 1		"	"	
3		7-9	8-10	"Blueberries shorter and somewhat better returns are being realized for same".
4		"	"	Ditto.
8		7-9	8-11	"Blueberries clean up fairly well with best marks doing a trifle better"
10		"	"	
11		"	"	
14 (Monday)		"	"	"Blueberries continue to work off steadily with some extra fancy marks exceeding prices quoted".

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1908 (con) ~~New Brunswick~~ Nova Scotia

Sept. 15	7-9	8-11	"Blueberries are sticky and hard to place, with a wide range in price manifest on same".
17	7-9	8-10	"Blueberries are slow and a long range in prices prevails on same".
18	"	"	"Blueberries slow and easy".
21 (Monday)	7-8	7-12	"Blueberries are in lighter supply and have but a small call".
22	"	"	Ditto
24	"	"	"Only straggling lots of blueberries now offer and these are sold at wide ranges in price".
25	"	"	Ditto
28 (Monday)	"	"	"Blueberries are about done"
29	"	"	Ditto
Oct. 1	"	"	"Blueberries practically done, there being only a few stray lots coming in"
2	"	"	Ditto
5 (Monday)	—	—	"Blueberries done"

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1909 N.C.

June 8 13-22 "Blueberries cleaned up satisfactorily at a wide range in price".

10 10-18 "Stray lots of blueberries arrive and sell at a long range in price according to quality, condition, etc."

11 10-12 "Blueberries sell mostly around prices quoted but now and then an extra mark ranges much higher.

14 (Monday) " "Practically no blueberries offering".

15 " "No blueberries offering to speak of".

18 " "Practically no blueberries have offered for the past few days".

21 (Monday) " "Blueberries offer very scatteringly with practically no arrivals today".

22 " "No blueberries"

24 " "No blueberries to speak of".

25 " "Practically no blueberries ... on the market".

28 (Monday) " "Blueberries scarce and wanted".

29 " "Blueberries in limited ~~good~~ supply and good ~~limited~~ demand".

July 1 N.C. Penn. 15-16 "Blueberries have been arriving quite freely from Penn. for the past day or two and selling well but at gradually declining prices".

2 " "Blueberries move in good shape and keep well maintained in price".

Penn. Mass & N.H.

6 10-14 16-18 "Blueberries move well at good prices"

8 " " "Blueberries meet with a steady sale at well sustained prices".

9 12-14 15-17 "Blueberries have a steady call and work off gradually at well sustained prices"

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1909 (con.) Penn. Mass & N.H.

July 12 (Monday) 12-14 15-17 Blueberries also cleaned up well at practically unchanged quotations".

13 12-14 15-17 "Blueberries sold well in price but many lots showed "sweaty" and clean up slowly".

15 11-13 13-15 "Receipts of blueberries have been liberal this week but demand has been active and the market has held up well, although a lower market is in evidence today".

16 10-12 11-15 "Receipts of blueberries continue liberal with a great deal of slack packing showing up, especially the under layers".

19 (Mon.) 10-12 13-15 "Blueberries met with a steady demand and with a light supply offering did a trifle better this morning".

20 10-- 12-14 Blueberries met with a steady demand and with moderate supply offering hold fairly steady".

22 9-10 10-12 Maine 10-12 Receipts of blueberries have increased materially during the past week, and although there is a steady demand for same the market has gradually eased off in price".

23 " " " "Receipts of blueberries lighter and with a steady demand for same the market holds up firm".

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1909 (con.)	Penn.	Mass. & N. H.	Maine	
July 26 (Mond.)	10-11	11-14	12-15	"The supply of blueberries was also very moderate and full prices were returned on same".
27	"	"	"	Ditto except "is moderate".
			Nova Scotia	
29	— 10	10-12	10-12	12-13 Receipts of blueberries liberal and a much easier market prevails on same".
30	—	10-12	10-12	11-13 Ditto but "and an easy market"
Aug. 2 (Mond.)	"	"	"	"Blueberries hold steady and meet with a good sale at general prices quoted".
3	10-12	10-12	11-13	Ditto.
5	"	"	"	"Blueberries continue to find a good market and keep for the most part well cleaned up".
6	"	"	"	Ditto
9 (Mond.)	10-12	10-12	10-12	"A liberal supply of blueberries this morning and stocks, unless extra fancy, moved only indifferently"
				New Brunswick
10	10-11	10-11	10-11	9 — Ditto and "N.B. offerings are extremely poor and have to be cleaned up at low figures".
12	9-11	10-11	10-11	8-9 "The blueberry market has gradually eased off during the week and receipts clean up slowly at quotations".

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1909	Mass. & N.H.	Maine	Nova Scotia	New Brunswick	
Aug. 13	9-11	10-11	10-11	8-9	"The blueberry market remains steady with no change to note"
16 (Mond.)	8-10	8-10	8-10	7-9	"Blueberries plenty and selling generally at 8 to 10 ¢ per quart as to quality and condition".
17	"	"	"	"	Ditto and "with some of the best Nova Scotia at 11¢"
19	8-12	9-12	9-12	8-10	"Blueberries were plenty early in the week at 7 to 10¢, but since the rain Tuesday receipts have been light and prices higher
20	10-12	10-12	10-12	10-12	"Blueberries in light supply today and good big berries sell easily at 12¢."
23 (Mon.)	"	"	"	10-—	"Blueberries hold well but begin to show lateness of season".
24	"	"	10-13	"	Ditto.
26	9-12	9-12	9-13	9-—	
27	9-11	9-11	9-11	9-—	

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1909	Mass + N.H.	Maine	Nova Scotia	New Brunswick	
Aug. 30	8-10	8-11	8-11	8-10	Blueberries arriving in many cases soft and all such sell at inside figures
Aug. 31	"	"	"	"	Ditto.

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TAXONOMIC INVESTIGATIONS.

Bog on my farm for blueberry

2 races
Test file

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TAXONOMIC INVESTIGATIONS.

[illegible] N. H. Sept. 9, 19[illegible]

Pruning

Sawed all [illegible] north of the swamp. [illegible] the largest 3.5 by 2.7 cm. [illegible] But in [illegible]

[illegible]

[illegible] the largest [illegible] cm. [illegible]

Removed [illegible] from the [illegible] bush leaving only the [illegible] and one other. Bud all right. [illegible] about 1 cm. [illegible] about 1.5 cm.

[illegible] ½ teacupful, [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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TAXONOMIC INVESTIGATIONS.

Greenfield, N. H., Sept. 9, 1909.

Blueberry meadow. List of 1908 seedlings reset in the spring of '09, in place of 1907 seedlings which were dead or feeble in the spring of [illegible].

Row 1 (from east)
Plant 1 (from [illegible]) (Cultures [illegible])
2 "
3 (4[illegible])
6 "
11 (72)
15 "
16 (72 [illegible])
20 (72 A)
24 (72 A)

Row 2
Plant 7 (4[illegible])
10 "
13 "

Row 3
[illegible] 7 (44)
14 "

Row 4
Plant 2 (4[illegible])
6 "
10 "
13 "

Row ~~3~~ 5
Plant 5 ([illegible])
6 "
7 "
8 "
11 (no number) (50)

Row ~~3~~ 6
Plant 1 (50)
3 "
6 "
7 "
10 "
11 "
14 "
16 "

Row 7
[illegible] 10 (50)
12
13
16
17
18

Row 8 Plant 18

Row 9
Plant ~~2~~ 6 ([illegible])
12

Row [illegible]
[illegible] 7 [illegible]
8 "
18 "
2[illegible] "

[illegible]

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TAXONOMIC INVESTIGATIONS.

[illegible] Sept. 9, 19[illegible]

Blueberry meadow

Row 1 (from east)

Plant 1 (from south). Broken bush seedling of 1908. [illegible] 13 cm ~~130 mm~~ ~~1300 mm~~; no flowering buds. Culture [illegible]

Plant 2. 1908 seedling, ~~[illegible]~~ ~~15 cm~~ high, no flowering buds [illegible]

~~Seedling Height of stem Flower buds~~

~~Plant~~ ~~Culture~~	Seedling	Culture	Height cm.	Flower buds	Remarks
Plant 3	1908	44	15	Apparently	
4	1907		16	None yet	
5	"		12	"	
6	1908	45	22	Apparently	
7	1907		11	None yet	
8	"		14	None	
9	"		11	"	Feeble, few leaves
10	"		16	None yet	
11	1908	72	22	Apparently	One bud alive [illegible] on [illegible]
12	1907		15	None	
13	"		17	None	Much [illegible] feeble
14	"		10	"	Longest stem old one. Younger shoots [illegible] leaves.
15	1908	72	24	"	
16	"	72A	25	Apparently	
17	1907		13	None yet	
18	"		11	None	Not very strong
19	"		20	None yet	[illegible]
20	1908	72A	20	Appar[illegible]	
21	1907		17	None yet	Plant large but not vigorous
22	"		23	None	
23	"		15	None	Pair [illegible]
24	1908	72A	17	None yet	
25	1907		22	None yet	
26	"		16	"	

Greenfield

Blueberry meadow (con)

Row 2	Seedling	Cuttings	Set out	Height cm.	Flowering	Remarks
Plant 1	1907		1908	16	None yet	Two plants, taller measured
2	"		1908	[illegible]	"	Two plants apparently, one flowered
3	"		1908	12	"	
4	"		1908	10 & 12	Apparently	Two plants
5	"		1908	12+10	None yet	
6	"		1908	18	Apparently	Old stem longest
7	1908	45	1909	17	None	
8	1907		1908	12	None yet	
9	"		"	12	None	
10	1908	45	1909	27	Apparently	
11	1907		1908	18	None yet	
12	"		"	14	"	
13	1908	45	1909	19	None	
14	1907		1908	15	None yet	
Row 3						
Plant 1	1908	44	1909	25	None yet	
2	1907		1908	13	None	
3	"		"	10	"	
4	"		"	14	None yet	
5	"		"	11	None	
6	"		"	13	"	
7	"		"	18	None yet	
8	"		"	13	None	
9	"		"	12	None	
10	"		"	11	"	
11	"		"	11	"	
12	"		"	9	"	
13	"		"	20	None yet	
14	1908	44	1909	14	None yet	Old stem longest
15	1907		1908	16	None	
Row 4						
Plant 1	1907		1908	12	None	
2	1908	44	1909	22	None yet	
3	1907		1908	16+17	"	Two plants
4	"		"	3	None	
5	"		"	12+10	"	
6	1908	44	1909	21	None yet	

Greenfield, N.H., Sept. 7 - 9 [illegible]

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(Blueberry meadow (con.)

TAXONOMIC INVESTIGATIONS.

	Seedling	Cutting	Set out	Height cm.	Flowering buds?	Remarks
Row 4 (con.)						
Plant 7	1907		1908	12	None	Apparently two plants, south one removed
8	"		"	12	"	
9	"		"	16	"	
10	1908	44	1909	20	None yet	
11	1907		1908	12	None	
12	"		"	22	None yet	
13	1908	44	1909	15	" "	
14	1907		1908	12	None	
15	"		"	17	Apparently	
16	"		"	16	None	
Row 5						
Plant 1	1907		1908	18	None	
2	"		"	12	"	
3	"		"	13	"	
4	"		"	17	None	Plants apparently 3, 2 south [illegible] removed
5	1908	50	1909	22	None yet	
6	"	"	"	25	" "	
7	"	"	"	26	Apparently.	Short [illegible]
8	"	"	"	30	None yet	
9	1907		1908	10	None yet	Two plants, south [illegible] removed
10	1908		1909	19	None	
11	1907		1908	8 + 14	None yet	Two plants
12	"		"	13	None	
13	"		"	10	"	
14	"		"	14	None yet	
15	1908	50	1909	17	None	
16	1907		1908	19	None	
Row 6						
Plant 1	1908	50	1909	18	None	
2	1907		1908	16	None	
3	1908	50	1909	30	None yet	
4	1907		1908	14	None	
5	"		"	19	None	
6	1908	50	1909	20	None yet	Shows [illegible]
7	1907		1908	20	Apparently	
8	"		"	15	Apparently	[illegible]
9	1908		1909	30	None yet	New growth 16.5 cm.

Greenfield, N. H., Sept. 9, 1909 (4

Blueberry meadow (con)

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.
TAXONOMIC INVESTIGATIONS.

	Seedling	Cutting	Set out	Height cm.	Flowered	Remarks
Row 6 (con.)						
Plant 10	1908	50	1909	19	None.	Longest stem [illegible] above
11	"	"	"	18	"	Old stem longest.
12	1907		1908	16	None	
13	"		"	17	"	Two plants, northernmost removed
14	1908	50	1909	26	None	
15	1907		1908	24	Apparently	
16	1908	50	1909	18	None	Old stem longest
17	1907		1908	17	None	
Row 7						
Plant 1	1907		1908	25	None yet	
2	"		"	16	"	Two berries just dropped off without ripening
3	"		"	18	"	
4	"		"	22	"	
5	"		"	16	"	
6	"		"	16	"	
7	"		"	8 + 12	None	Two plants.
8	"		"	10	Apparently.	Bushy [illegible]
9	"		"	16	Apparently	
10	1908	50	1909	25	None yet	Longest [illegible] cm.
11	1907		1908	11	None	
12	1908	50	1909	16	None	
13	"	"	"	19	None yet	
14	1907		1908	11	None	
15	"		"	17	None yet	
16	1908	50	1909	17	"	
17	"	"	"	"	None	
18	"	"	"	23	"	
Row 8						
Plant 1	1907		1908	14	None	
2	"		"	29	None yet	
3	"		"	20	"	Leaves nearly all reddened
4	"		"	21	None	
5	"		"	15	"	
6	"		"	24	Apparently	
7	"		"	22	None yet	
8	"		"	21	None	
9	"		"	23	Apparently	
10	"		"	24	None yet	

Greenfield, N. H., Sept. [illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF PLANT INDUSTRY,

WASHINGTON, D. C.

TAXONOMIC INVESTIGATIONS.

Blueberry nursery

	Seedling	Cutting	Set out	Height Ins.	Flowering buds	Remarks
Row 8 (Con.)						
Plant 11	1907		1908	17	None yet	
12	"		"	18	None	
13	"		"	21	None	
14	"		"	17	None	
15	"		"	11	"	
16	"		"	15	"	
17	"		"	23	"	
18	1908	50	1909	15	None yet	
Row 9						
Plant 1	1907		1908	22	None yet	
2	"		"	16	"	
3	"		"	16	Apparently	
4	"		"	13	None	
5	"		"	20	"	
6	1908	50	1909	27	Apparently	
7	1907		1908	20	None	
8	"		"	17	Apparently	
9	"		"	21	None	
10	1908	50	1909	31	None yet	
11	1907		1908	23	None yet	
12	1908	50	1909	17	None	
13	1907		1908	15	"	
14	1908	50	1909	18	None.	Old stem [illegible]
15	1907		1908	17	None yet	
16	"		"	17	None	
17	"		"	25	None	
18	1908	50	1909	16	None	
19	1907		1908	20	None	
Row 10						
Plant 1	1907		1908	15	None yet	
2	"		"	16	None	
3	"		"	13	"	Plant feeble
4	"		"	12	"	" "
5	"		"	17	"	
6	(Pine [illegible]		—		—)	
7	1908	50	1909	20	None yet	
8	"	"	"	22	None	All old wood but [illegible] green, moist and shade situation

[illegible]

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WASHINGTON, D. C.

TAXONOMIC INVESTIGATIONS.

Blueberry meadow (con.)

Row 10 (con.) Plant 9	1907		1908	24	None yet	
				21	Apparently	
10	"		"	17	"	
11	"		"	22	None	
12	"		"	15	"	Much eaten by [insects
13	"		"	19	"	
14	"		"	"	"	
15	"		"	25	None yet	
16	"		"	20	None	Much eaten by insects
17	"		"			
18	1908	30	1909	18	None yet	
19	1907		1908	22	None yet	
20	1908	30	1908	20	None	Tallest [illegible] [above

UNITED STATES DEPARTMENT OF AGRICULTURE,
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WASHINGTON, D. C.

En route [illegible] Apr. 10, 1907

Is not the [illegible] the [illegible] substance in the clay loam about Washington, [illegible] the [illegible] disease [illegible] of [illegible] and also [illegible] of seedlings in peat and in [illegible] sand [illegible] charged with iron. Does the iron act by tying up all the phosphoric acid

Sept. 14, 1909

Budded by Mr. Boyle on Sept. 2 & 3, 1909, with Brooks bush buds sent on [illegible] twenty-six plants, as follows; three in 1908 seedlings; the others on 65, 1 plant
89A 2 ~~plants~~.

Culture 133. One of the cuttings potted July 12, 1909, has died. The ~~plant~~ was discarded.

Culture [illegible]. Tall plant [illegible] measures 693 mm.

Culture . Twenty cuttings from the [illegible] bush placed by Mr. Gayis under a [illegible] in new ordinary [illegible] propagating sand in the propagating house [illegible]. These cuttings were made [illegible] Sept. [illegible] '09.

Culture . Twenty-one cuttings [illegible] same as last entry].

The ~~[illegible]~~ coverings which all through the summer, on sunny days, were kept over the out door plants from 9.00 A.M. to [illegible] M., and which, beginning about Aug. 25 were used from [illegible] to [illegible], began, [illegible] to be left off altogether. The plants are [illegible] laying down flowering buds, though many have not [illegible] still [illegible].

[illegible]

[illegible]

and [illegible]

[illegible] β. [illegible] being [illegible] [illegible] [illegible]
[illegible] 15% [illegible] by the [illegible]
[illegible] The [illegible]
[illegible] in Germany [illegible]
[illegible]
[illegible]
to [illegible]

[illegible] The (two others) [illegible]
[illegible] in Germany [illegible]
nothing [illegible]

Sept. [illegible]

[illegible] 192. [illegible] cuttings [illegible] [illegible]. One [illegible] all the [illegible] [illegible] [illegible]. The roots reached [illegible] [illegible] [illegible] 6 cm [illegible] [illegible] 20 cm. Seven [illegible] [illegible] ~~six~~ eight [illegible] 3-inch pots. Mixed [illegible] [illegible] [illegible] 192 h. [illegible] [illegible]

Cuttings 192 h. Mixed plant from Cuttings 192 [illegible] 3-inch pots, [illegible] glass sand [illegible]

[illegible] 154. [illegible] [illegible] cuttings [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

Cuttings 199. Forty [illegible] cuttings from the [illegible] [illegible] [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] Sept. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

Cuttings 193. Seeds [illegible] [illegible] [illegible] germinate

Sept. 16, 1909.

Culture 1150. A bed prepared in the [illegible] with fine-sifted peat 4 in. deep (plate sand [illegible]) overlying a peat fiber bottom, sowed to-day with seed from the [illegible] bush, Greenfield, N. H.

Sept. 20, 1909

Cutters 187. Bud dead, had been healed on in part
~~188~~ 189 " " , never healed on
" " "
181 ~~Bud~~ living
182 " "
189A " "
190 " "
191 One bud dead, one alive.
184 Bud living
189B " "

The plants in 4-inch and 3-inch pots are not so dark green and heathy as those in 6-inch pots

Epigaea repens, Seeds still germinating.

Cutters 196. This number is given to the cuttings of *Vaccinium pennsylvanicum* from the large [illegible] patch on Mr. Frank Russell's farm at [illegible]field, N.H. They were put in the ~~[illegible]~~ outside propagating frame August [illegible] [illegible] bud growth has started on nearly all of them [illegible] the new growth is 3 cm long. Two [illegible] taken up and put back in the soil again ~~[illegible]~~ shows no new roots.

Cutting 197 Some root cuttings taken from the ~~[illegible]~~ same [illegible] as cutting 196 ~~root cuttings of the~~ [illegible] in the [illegible] propagating [illegible] [illegible] [illegible] 31 [illegible]. No shoots [illegible] [illegible] new growth [illegible]

Sept. 23, 1909.

Culture 179. Only one cutting [illegible] a leaf, and [illegible] others ~~[illegible]~~ [illegible] stems. These [illegible] removed, without [illegible], and [illegible].

Culture 177. Cuttings all alive and [illegible] growing, one with new growth 11 cm long.

Culture 173. ~~Plants~~ Cuttings apparently all starting

Culture 178. [illegible] eight cuttings appearing superficially to be in good [illegible], but several dug up show no roots, nor any callus. Slight growth [illegible] from [illegible] in some.

Culture 171. Cuttings all well started.

Culture 172. Cuttings all dead and removed, [illegible] three, these leafless, [illegible] and [illegible].

Culture 169. Cuttings all dead

170 " " "

166 " " "

Culture 167. Three cuttings alive, leafless. These dug up were well callused, but with no roots.

Culture 168. [illegible] cuttings [illegible] [illegible] several dug up [illegible] [illegible] [illegible] [illegible] [illegible] with [illegible] [illegible] callus. [illegible] [illegible]

Sept. 20, 1909.

Cutting 158. Five cuttings, all still with leaves, part with callus, part without, none dead at the base, none with roots.

Cutting 156. Last cuttings dead.

Cutting 160. Last cuttings dead some time ago.

Cutting 194. Five leaves yellowed or brown, [illegible].

Sept. 22 1909

Culture 198. This number is given to a eight inch saucer, sowed with seeds of [illegible] [illegible] Aug [illegible] by Mr Gouger in a [illegible] [illegible] and [illegible] similar [illegible]. The seed were not germinated [illegible].

Culture 199. This number is given to a [illegible] [illegible] saucer sowed with seeds of [illegible] [illegible] Aug [illegible] by Mr Gouger in a [illegible] and [illegible] similar [illegible]. No seeds germinated as yet.

Culture 200. This number is given to ~~[illegible]~~ [illegible] ~~[illegible]~~ [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

Sept. 29/1907.

Mr. Oliver says that Mr. Grieve, Redbraes Nursery, Edinburgh, has raised *Rhododendron* seedlings by the thousand, and is an expert in this business

Culture 178. Some of the Dendrium cuttings are beginning to callus.

Sept. 30, 1909

Culture 201. Rhododendron maximum. Eighty-five plants taken from Culture 161, and transplanted into a flat at about two inches distance from each other. The seedlings have one to three leaves besides the cotyledons, the largest leaves having a length of about 1 cm. Soil 9 parts kalmia peat rubbed through a quarter-inch sieve, 1 part glass sand, underlain by a drainage mass of kalmia peat fiber. Transplanting by Harry Boyle. Placed in outside propagating frame.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Sept. 30, 1917

Etherizing. ask Oliver about process, published a [illegible]
([illegible] for [illegible] [illegible] [illegible])

Gay. Lum.

[illegible]	17	
[illegible]	6	13
[illegible]	5	4
[illegible]	4	
[illegible]	5	
[illegible]	9	
[illegible]		11

[illegible]		2
[illegible]	1	
[illegible]	3	7
[illegible]		3
[illegible]	1	4
[illegible]	3	6
[illegible]	2	13
[illegible]	2	6 ~~3~~
[illegible]	2	5 ~~4~~
[illegible]		9 ~~5~~
[illegible]	2	
[illegible]	2	6
[illegible]	2	11
[illegible]		4
[illegible]	3	13
[illegible]	2	15
	31	102

Cont "Buses 2" the Expiration [illegible] of August 24, 1934, the [illegible]

permost buds of the cut branches were transformed into flowering buds even when the cut was made some distance below the lowest of the buds that would have developed into flowering buds.

Oct. [illegible] 1917.

Culture 158. Remaining 5 cuttings still in bed but they are away. [illegible] callused, [illegible] no roots.

Culture 156. Cuttings all removed, [illegible] callused, mostly blackened [illegible] to surface of sand.

Culture 157. Cuttings all taken up [illegible] in good callus but [illegible] put back to see if they will root.

Culture 174. For several days the upper ends of the cuttings have been turning to a sheddish yellow [illegible], brown and [illegible] dropping off [illegible]. [illegible]

[illegible]

Oct. 2, 1909.

Culture 202. *Gaylussacia dumosa*. Rootstock-stem cuttings, , from Lanham, Md., Oct. 1, ~~from~~ along the roadside west of Scofield's pine woods. Propagating frame, glass sand.

Culture 202 A *Gaylussacia dumosa*. Rootstock cuttings, , from [etc as above]

Culture 203. *Polycodium*, rootstock-stem cuttings, from Lanham, Md. Oct. 1. Trail bush, from the pine woods on the trail from Scofield's to Brown's. Propagating frame, glass sand.

Culture 203A. *Polycodium*, rootstock cuttings, Eight [illegible] second row [illegible] From Lanham [etc as in 203]

Culture 204. *Leucothoe racemosa*, rootstock-stem cuttings, 4, Lanham, Md. Oct. 1, south edge of the Collins-Scofield woods. Propagating frame, glass sand.

Culture 204 A *Leucothoe racemosa*, [illegible] Eight cuttings from rootstocks [illegible] this year's in second row. From Lanham [etc as in 204]

Culture 205. *Prunus americana*, ~~[illegible]~~ [illegible], 26 cuttings, from thicket west of Scofield's orchard, Lanham, Oct. 1. Propagating frame, glass sand.

~~Culture 206. Prunus americana, rootstocks~~.

Culture 205 A *Prunus americana*, rootstocks, 12 cuttings, from thicket [etc as in 205]

Oct. 2, [illegible]

Cutting 206 Vaccinium [illegible]coccum ~~Swingle bush~~ roots, 10 cuttings. Swingle bush, in the pine woods, Scofield-Brown trail, Lanham, Md., Oct. 1, 1909. Propagating bed, glass sand.

Cutting 207 Vaccinium [illegible]coccum, ~~Swingle bush~~ 20 tiny cuttings. Swingle bush [do as in 206]

Cuttings 208 ~~Swingle bush~~ Vaccinium [illegible]coccum Swingle bush, 15 tiny cuttings and [illegible] rooted cuttings (same as #206 + 207) are [illegible] in [illegible]. Green house on yellow sand without cover.

[illegible] Remaining cuttings [illegible]
[illegible] except two.
[illegible] with no shoot. These had been
[illegible] two of these [illegible]
[illegible]

[illegible] Remaining cutting shed one
leaf [illegible] yellow [illegible]
[illegible]

[illegible]
45 [illegible]
The [illegible] buds look very [illegible]

[illegible] 1908 [illegible] Flowering buds [illegible]
[illegible] formation.

[illegible]

[illegible]
[illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Oct. 5, 1909.

Pruning experiment for the summer of 1910.

Immediately after a wild plant of Vaccinium has laid down its flowering buds for the succeeding year, cut off some, say half of the ~~stems~~ and see if the remaining stems will not proceed to lay down new flowering buds additional to those already laid down.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Oct. 5, 1909

The pruning experiments recorded under the dates August 24 and October 1, 1909, showed (1) that if, immediately after the flowering buds for the succeeding year are formed, that portion of a twig bearing these buds is cut off one or more of the leaf buds below the cut proceed to transform themselves into flowering buds and (2) that (over) These results would indicate that in blueberry culture a moderate superficial pruning of the twigs may safely be ~~made~~ given in the period after the fruit is gathered and before the flowering buds for the succeeding year are developed, without necessitating the loss of a fruit crop in the succeeding year. If such a pruning were ~~made~~ given at the end of the growing season, or during the winter, or in early spring the flowering buds cut off would not be replaced by others and all their fruit would be lost. If a superficial pruning ~~should~~ proves to be an advantageous method of stimulating crop production the best season for the pruning would seem to be just after fruiting, unless it turns out

when a little earlier, just before the flowering buds are developed, the ends of twigs are cut off the uppermost buds of the cut twig develop into flower buds.

[illegible] foliage in late summer impairs, ultimately the vitality of the plant

Oct. 5, 1909

[illegible] the twenty-six [grafts with budded with] buds of the Brooks [illegible] by Harry [illegible] on Sept. 2 and 3. [illegible] plants with [illegible] buds were brought into a greenhouse, [illegible] [illegible] cut back so as to force [illegible] to grow if possible. These plants [illegible] [illegible] and of the following [illegible]

Cultures [illegible], 11, 17, 21, 70. To be repotted [illegible]

[illegible] Nos 182 [illegible] brought into the [illegible] greenhouse and cut back [illegible] the [illegible] if possible. To be repotted in [illegible] pot.

[illegible] Plants [illegible] greenhouse [illegible] cut back to force buds if possible. To [illegible] [illegible] inch [illegible]

[illegible] 197. [illegible] have [illegible] [illegible] that have reached the surface [illegible]

[illegible] 24. [illegible] cuttings now [illegible] [illegible]

Oct 6, 1909.

Pruning experiment. A plant of Culture 56 is pruned by removing 9 basal stems of various sizes, the largest stem being left. This is about 46 cm. high with 56 leaves. In axils 1 to 7, and 9, from the top flowering buds have developed. The experiment is designed to ascertain whether additional flower buds will be laid down. This plant was still making new growth on some of the stems that were cut off.

Pruning experiment. A plant of Culture 47 is pruned by removing 7 basal stems, the largest one being left. The stem is about 51 cm. high. It has laid down a flowering bud in the uppermost axil. On the lower stem have been laid down 5 flowering buds, two on the main axis, one on the upper branch, two on the lower branch, all in the upper axils. Will additional buds be laid down. None of the stems removed was making new growth.

Pruning experiment. 43(5) is pruned by removing 9 basal stems of various sizes, the best (but not largest) one being left. This is about 45 cm. high and has a flowering bud in the uppermost axil. Growth on the cut branches has ceased. Will new flowering buds be laid down.

Oct. 5 1907

[illegible] 19th. Thirty [illegible] [illegible] [illegible] [illegible] now
cost all [illegible] [illegible].

Culture 20th. Twenty-eight plants of [illegible]
[illegible] taken out of Culture 200 and
placed in an eight-inch saucer with
peat & glass [illegible] 1. The plants [illegible]
one [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]
[illegible] [illegible] [illegible] of only about 3 mm.

1

Oct. ...

Culture 176. Polygonum ... Some ...
cuttings potted ...
...

Culture 177. Polygonum ...
cuttings [etc. as ...]

Culture 178 Polygonum ...
cuttings [etc. as ...]

Culture 117 Vaccinium ...
seven sprouts now visible above the ...

Culture 196 Vaccinium ...
about 15 cuttings ...
... 3 ...
... made ... Some ...
... need ...
... no ...

Sarracenia ...
... the ...
...
... 20 ...

Oct. 7, 1907

Culture 210 Azalea [illegible]. Eighty [illegible]
seedlings taken out of culture [illegible]
set [illegible] in a flat, 2 inches apart in
[illegible] flat 9, glass covered, [illegible]
by Miss [illegible]. The seedlings [illegible]
mostly 5 to 6 leaves besides the coty-
ledons, the largest being [illegible] 1.5 cm long.
Branches are already [illegible] [illegible] some
from the lowest axils. The [illegible]
[illegible] before expanding. Pinched. [illegible]
[illegible] shade.

Culture 164 Thirty [illegible] of
Leucothoe racemosa, set out in
a flat, 2 inches [illegible]
in [illegible] flat 9, glass covered, [illegible]
[illegible] all the seedlings [illegible]
in Culture 164. They are [illegible]
from no [illegible] [illegible]
[illegible] leaves. Tallest plant 3.5 cm [illegible]
largest leaves 1.5 cm long.

~~To ... greenhouse~~ [illegible]

[illegible]

Culture 64   12 plants 7 in pots, [illegible] planted in sand

6 + A

Culture [illegible], [illegible] plants 4 in pots

Culture 13 [illegible]

Culture 43 & 2 (Down) [illegible]

Culture [illegible] [illegible] plant

Culture [illegible]

Culture [illegible] 6 plants.

Culture 77 Dendrium 1 plant

13 [illegible] " "

[illegible] – [illegible]

Culture 194. Thirty [illegible] cuttings with no leaves, nine with leaves one each.

Culture [illegible]. Remaining 4 cuttings [illegible] [illegible] from the [illegible] house [illegible] ([illegible] [illegible]). These [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. Two [illegible] with a good [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] in [illegible] feat 8 [illegible] 2, [illegible] feet. [illegible] [illegible] [illegible] [illegible] [illegible]

Culture 157. The single [illegible], the only one left except 157A and 158, [illegible] a good [illegible] [illegible] and [illegible] [illegible] [illegible] but no roots. Potted in a [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] 2 [illegible] fine
[illegible] Idaho [illegible] a flat
[illegible]

(main stem [illegible])
[illegible] flowers

buds as follows:

Largest stem	6 flowering buds
Mainaxis	
Uppermost branch	4
"	5
Next "	3
" "	1
Next "	4, 3
Next "	4
Next "	2
Another stem	2
" "	~~5~~ 3
" "	3
" "	2
	72

[illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C. Oct. 12, [illegible]

The out door plants have made [illegible] progress in the laying down of flowering buds since October 9, that is the buds in [illegible] of swelling are distinctly larger.

Many of the plants in 3-inch and ~~3~~ 4 inch pots have reddened their foliage, [illegible] the leaves in [illegible] [illegible] [illegible]

On plants still vigorously growing when the cool weather comes the coloration is dark purple; on injured leaves and poorly nourished plants ~~[illegible]~~ and on the lower parts of the stem as coloration [illegible] arises, a ~~bright~~ bright red. In a few cases leaves formerly injured ~~by~~ the careless mowing of the shoots where their midrib was broken are bright scarlet on a stem with otherwise purple leaves.

[illegible] 183. Tying removed from [illegible] in [illegible] [illegible]
" 191. Tying removed, bud [illegible] ~~[illegible]~~ [illegible] [illegible] ~~[illegible]~~
[illegible] but [illegible] [illegible]
181B Tying removed, bud wood [illegible] [illegible]

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Oct. 12, 1909

Of the buds in the Brown bush put into 1907 and 1908(?) seedlings on Sept 2 & 3 by Mr. Boyle, 13 were taken out dead today. These were all on 1907 plants. All those of the 1908 seedlings had lost their buds.

In nearly every case the ~~entire surface~~ wood of the stock had callused over the entire inner surface of the wood and bark of the bud. The union had been made with the bud in these cases notwithstanding the fact that in some the pith on the bud wood was still somewhat green, and in one or two a bit of the bark was still green. The bud wood although fed with moisture from the stock appears to be exceedingly sluggish in the matter of union. This leaves outdoors only four living buds of this lot, all budded Sept 2, 1909.

Of the 1907 seedlings budded on Aug. 12, '09, with feijoa buds, seven out of nine are still alive, 181, 183, 184, 189 A, 189 B, 190, 191, but none were assured of success

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Cutting 132. The two [illegible] flowering [illegible] [illegible] laying [illegible] [illegible]

Cutting [illegible] [illegible] large buds, [illegible] [illegible] have been additional [illegible] [illegible] in the [illegible] [illegible] as [illegible] [illegible] [illegible] the [illegible] bud from the follows; one [illegible] summit of the shorter fork [illegible] main branch, making four flowering buds on this fork, the other in the eleventh axil of the main branch below the fork

Cutting 119. One leaf each on ~~five~~ two cutting [illegible] [illegible], other [illegible]. One cutting [illegible] removed the [illegible] [illegible] below. On [illegible] [illegible] [illegible] with a [illegible] summit, the [illegible] [illegible] bud is swelling, but [illegible] [illegible] because of differentiation into a flowering bud, not in [illegible] for branch production

Cuttings 205. Four cuttings have lost their leaves.

Cuttings 207. One cutting [illegible] for [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] lost its leaves a few [illegible] [illegible] [illegible] [illegible] slipping [illegible].

[illegible] 1 [illegible]

Cutting [illegible] A root cutting [illegible] up

[illegible] had begun to callus along the

cambium at [illegible] ends.

Cutting 202 A. Two root cuttings taken

up [illegible] showed [illegible] of callus

at [illegible]

Cutting 202. A rootstock stem cutting

taken up [illegible] showed no signs of [illegible]

on the cut surface, but a bud on

the ~~[illegible]~~ underground [illegible]

of the rootstock was [illegible].

Cutting 203. A rootstock [illegible] cutting [illegible]

up [illegible] shows the beginning of [illegible]

along the cambium, [illegible]

the first shoot [illegible] [illegible]

Cutting 204 A. Two cuttings [illegible]

[illegible] one [illegible] the [illegible]

[illegible] is apparently [illegible]

[illegible]

[illegible] 204. [illegible]

[illegible] one [illegible]

[illegible]

Cutting 205 A. One [illegible]

[illegible]

[illegible] Cuttings [illegible]

Cutting 205 [illegible]

Cutting 206. [illegible] Two [illegible]

[illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible],

[illegible] [illegible] [illegible] [illegible] [illegible]

Smithsonian bushes. Note the peculiar appearance of the forming buds, which look as if they were swelling preparatory to opening. They are simply expanding and extending in the process of forming the flower buds visible. The [illegible] [illegible] [illegible] yellowish green [illegible] [illegible] not yet blossomed or even [illegible].

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WASHINGTON, D. C. Oct. [illegible]

Cutters 201. One plant found [illegible] [illegible] at the surface of the ground. Shade required.

Cutters 210. Plants all alive and ~~[illegible]~~ growth apparently begun. Shade [illegible]

Cutters [illegible]. Plants all alive and in good shape.

Trecasiana [illegible] (Cuttings P.I.N. 269) Twenty eight plants in 3 inch pots. Sowed [illegible], by ~~Harry~~ Boyle in a sphagnum [illegible] [illegible] [illegible] ~~[illegible] 2at and [illegible]~~ [illegible] spring [illegible] to-day in the ~~[illegible]~~ [illegible]. All are growing and [illegible] little [illegible] 3 to 10 mm. high.

Culture 201 [illegible] [illegible] [illegible] [illegible]

[illegible]. [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible].

Culture [illegible] [illegible] [illegible] [illegible]

Culture [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

Culture [illegible]. [illegible] [illegible] [illegible] [illegible]

[illegible] by [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible], [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible]

[illegible] [illegible] [illegible] ~~[illegible]~~ [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] of [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] upper most [illegible]

[illegible]

[illegible] is good color but [illegible]

[illegible]

[illegible]

[illegible]

[illegible] 98. None germinated yet.

[illegible] 98. [illegible] continuing

[illegible] 160. [illegible] germinating [illegible]

[illegible] 168. Four [illegible]

[illegible] Three [illegible]

[illegible]

yet [illegible]

[illegible] 178. [illegible]

[illegible]

[illegible] 150 [illegible]

[illegible] 1760 [illegible]

[illegible]

[illegible] 200 [illegible] and [illegible]

[illegible]

[illegible] of 12 [illegible]

[illegible]

Oct. 15, 1907.

Culture 207. One plant eaten off by an insect.

Culture 208. Six of the twig cuttings have now lost their leaves.

Culture 216. A plant of Culture ~~[illegible]~~ 71, budded by tongue graft Sept. 2, 1907, [illegible] Bourbon [illegible]. The [illegible] in good condition, old stems [illegible] budded [illegible] off. Pot (5-inch) [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

Oct. 6, '11.

Culture 155. Moved to house no. 1. The low and feeble in [illegible] pit imperfectly, [illegible] the [illegible] propagating frame seems to offer little stimulation to growth. Many of the germinated seeds appear [illegible] been planted [illegible] enough, or [illegible] seed has on the [illegible] as the ~~seed~~ planted [illegible] finally [illegible] it is able to get the root, [illegible] Ted, [illegible] [illegible] to [illegible].

Culture 159. Moved into house no. 1 [illegible] except the [illegible], [illegible] glass

Culture 160 [Same as 159]

Culture 183 [Same as 1[illegible]

Culture 190 [Same as 159]

October 24.

Culture 200. Ten of the living cuttings have lost their leaves. Two cuttings discarded neither callused, one dead, the other partly so.

Culture 124. Seven of the cuttings cut at the tip now show a yellow swelling of the uppermost leaf node, which is now developing into a flowering bud.

Culture 211. Four plants were found cut off beneath the soil surface in Pot 6.

Culture 210. Two plants are now gone.

Culture 95. Cotyledons on many seeds expanding.

Culture 157. Pericarp halves removed from two seedlings. The cotyledons remain enclosed in a tightly fitting membranous sack.

October 20. 1901.

Culture 200. Epigaea. Second [illegible] leaf in several plants now as large as the cotyledons, Some plants becoming [illegible]

Culture 11. One seed germinating. Is it a Polygonum. Sinker taken into the greenhouse,

Culture 109. Stem [illegible] of ~~[illegible]~~ [illegible] out of the ground [illegible]. The [illegible] seedlings [illegible] by carefully removing the [illegible] [illegible] [illegible] [illegible] The [illegible] [illegible] [illegible] [illegible] [illegible] cotyledons [illegible] [illegible] yet [illegible] The remaining ~~[illegible]~~ seedling [illegible] [illegible] ground.

Culture [illegible]. First [illegible] leaf in [illegible] [illegible] as the cotyledons.

Culture 115. [illegible] [illegible] [illegible] [illegible] [illegible]

Heavy frost last night. [illegible] ~~[illegible]~~ change is noticeable in the outdoor plants, except that the [illegible] [illegible] [illegible] [illegible] more general. Almost [illegible] [illegible] [illegible] [illegible] purpling, many [illegible] [illegible] [illegible] [illegible]

October [illegible]

Budded plants in the greenhouse [illegible].
Plants [illegible] 70, 21, [illegible] and [illegible] are [illegible]
[illegible] on their [illegible]-bud [illegible]. Those from
[illegible] 11 & 185 have not started. The [illegible]
not [illegible].

October 22, 1907.

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Culture 211. Seven plants now gone, but pulled by the worms, [illegible] cut off [illegible] readily by [illegible] bugs, Plants slightly purpled

Culture 201. One plant gone

Culture 209. Nine plants alive in outer ring, eight in next, five in middle. [illegible] purplish [illegible] are decidedly purple or purplish on the backs of the [illegible] and the calyx lobes. A plant [illegible] cut [illegible] off had two wire worms [illegible] near it

Culture 4313 This plant (amoenum type) has 38 flowering buds laid down, and some more apparently in process of formation

Culture 55. One small leaved many-stemmed plant [illegible] has 30 flowering buds.

In all the outdoor plants that have purpled [illegible] leaves [illegible] protected by shading from the light, remains green [illegible]

Culture 564. One of the small leaved many-branched plants has laid down 57 flowering buds.

Ov.

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] propose [illegible] determine of [illegible]

[illegible] [illegible] the ~~[illegible]~~ [illegible] [illegible]

and [illegible] [illegible] [illegible] large

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

but the many-[illegible] smaller [illegible]

[illegible] [illegible] [illegible] [illegible] serrulate

(amoenum type).

[illegible] [illegible] [illegible] The same is

true of the seedlings of 1907 and of

flowers [illegible] [illegible] [illegible] by

the [illegible] type.

Can these narrow leaved [illegible] be

hybrids of [illegible] and pennsyl. vanicum?

October 22, 1909.

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Culture 207. Five cuttings have lost their leaves.

Culture 167. Two cuttings taken up. On one the callus and an adjacent [illegible] of stem was dead; cutting removed. The other not rooted; replaced.

Culture 159, One of the seedlings from which the [illegible] leaves primarily was removed ~~it~~ still [illegible] sac, the other is out. ~~The one with the hanging bract~~ ~~is dead~~

Culture [illegible] None of the superficial seedlings [illegible] [illegible], though some have not [illegible] [illegible] radicle into the soil. In [illegible] atmosphere many would undoubtedly have dried up.

Cultures 157 A. 157 B. Repotted yesterday in [illegible] peat 5, glass sand 1, loam 1, [illegible]

Culture 208 One twig cutting taken out, [illegible] dry above, [illegible] dead. Only [illegible] two leaves. Front 3 root cuttings [illegible] without callus, [illegible]

Culture 210. Plants [illegible] somewhat [illegible] on the older leaves.

[illegible] Plants slightly [illegible] [illegible] [illegible] [illegible]

Oct. 23, 1909

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Culture 202 A. South cutting, with neither callus nor other evidence of life without, sickle at the two cut ends. Next cutting with two buds formed and growing one accidentally broken off, replaced [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] growth apparently a rootlet at the other end. Next cutting with buds pushing from beneath the [illegible] [illegible] rootstock, one rootlet about 3 mm long, replaced.

Culture 16. Three cuttings taken up [illegible] two.

Culture 17. One sprouted cutting taken up, rootlets begun

Culture 16. Five north cuttings taken up, two callused, three not; replaced, the two callused to the west.

Oct. 23/1909

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Culture 210. Eight plants taken out of the flat to-day, all but one gnawed off beneath the surface, the other one [illegible] roots dead and brown. Nine plants now gone altogether.

Culture 211. Two more plants removed, one with the root gone, the other [illegible]

Culture 216 Remaining stem cut back to within about half an inch of the bud.

Culture [illegible] several [illegible] examined, [illegible] in the end of the [illegible]

[illegible] Bud on one cutting swelling, two cuttings [illegible] up, no rootlets yet.

Culture [illegible] Bud on one cutting swelling.

Culture 203A South root cutting callused [illegible] North root cutting slightly [illegible] [illegible] several white globular [illegible] formed on the surface, having pushed through the bark.

Culture 207 [illegible] South cutting [illegible] [illegible]

Culture 205 A South [illegible] one [illegible] [illegible]

Oct. 23, 1909.

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217. An old plant of Vaccinium [illegible] received by express from Linville, North Carolina, secured on [illegible] Mountain. Set out in one end of a six-inch flat with bottom layer of coarse ashes in kalmia peat 4, glass sand 1, and placed in the propagating frame

217 A [Same as 217]

218. [Same as 217 to the end [illegible] six inch flat" [illegible] and placed outdoors under a slat shade"

218 A [Same as [illegible]

219 [Same as 217 to end of glass sand 1" and add "in a 6-inch window box 14 by 25 inches inside and placed out doors under a slat shade.

220. [Same as 217]

Cultures 215. Third plant from front with uppermost bud swelling.

Oct. 2[illegible] [illegible]

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[illegible] Mr. [illegible] [illegible] now [illegible] [illegible]
[illegible] [illegible] [illegible]

October 25, 1909

Culture 211. Six more plants taken out. In some the roots seem to be merely dead and dry. In two the root was cut quite off, and a sort of wire worm was found near by. The rootless or poor [illegible] plants may be [illegible] by a slight flaccid appearance not fairly wilted. Transpiration generally slow. Fifteen plants now gone from this plot.

1909

Experiment. When [illegible] seedlings are [illegible] try [illegible] and plunge the thumb pots in [illegible] sand, and [illegible] the [illegible] in [illegible] pot to see if the [illegible] will [illegible] through the water with [illegible] with similar pots walls of the [illegible] plunged in sand.

Culture 201. Two plants are now gone from the plot. Two of the live plants have their [illegible] most [illegible] withered, and ~~[illegible]~~ others look ~~[illegible]~~ as if stagnation [illegible] be occurring. None of the [illegible] were [illegible].

Culture 1?. Three cuttings taken up to-day, all [illegible] callusing, but no [illegible]. One put in [illegible], two put in thumb pots [illegible] glass [illegible] and put under the bell glass with the cuttings.

October [illegible] 1937

Culture [illegible]. No more seeds germinating. Three seedlings [illegible] forming. Flasks [illegible].

Culture [illegible]. No more seeds germinating, [illegible] seedlings [illegible] second [illegible]. Flasks [illegible].

Culture 57. [illegible] nearly [illegible] in [illegible] seedlings. Three seedlings, probably [illegible]

[illegible]

[illegible]

October [illegible]

Culture [illegible] There more [illegible] [illegible] apparently [illegible].

Culture [illegible] [illegible] the root [illegible] of [illegible] body.

Culture [illegible] at least [illegible] probably [illegible]

Culture [illegible] Second [illegible] [illegible]

[illegible]

Culture [illegible]

Oct. 27, 1909

Cultures 162, 185, 186 and the plants of 11, 17, 21, and 70, all in the little green house, cut back to-day to stubs, just above the bud. All the plants had started except 11.

In Leucothoe is shown in [illegible]

Culture 211, Culture 164 Leaves before expanding incurved in a cylinder, the edges meeting but not overlapping.

Culture 210. Leaves revolute before expanding, in cross section thus

Four more plants eaten off at the root, the plants reset to see how long they will remain without drying out. Two more found with roots rotted off.

Culture 209. One more plant found ~~with~~ eaten off at the surface of the ground and larva of wire worm type found in soil. The plants roots may have been dead before they were eaten as the color is bad and the leaf indument dead.

Culture 159. All nine seedlings with cotyledons out of the ground and free of the seed. Two more seed leaves have appeared.

Oct. 27, 1909

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Culture. Stanley bush seeds preserved in a bottle from the same lot sowed, were examined to-day. The larger seeds ~~are~~ about 1.2 mm. long. The embryo is minute, white, straight, nearly cylindrical, about .5 to .6 mm. long, about a fourth that length in diameter. It lies imbedded in a great mass of white endosperm.

The reason why these seeds require so long a time to germinate, about six weeks, undoubtedly is because the embryo must have time to grow to a much larger size than it has attained at the maturity of the fetus before it is ready to break open the seed coats.

Oct 26, '19

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Culture 95. Seedlings preserved — dry for examination for any infection.

Culture 105. One dead plant removed

Cultures 105 Pots taken out of the other greenhouse plunging and plunged in sand.

Culture 105A [Same]

135	"
135 A	"
138	"
138 A	"
133	"

Oct. 30, 1909

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Cuttings [illegible], all the eleven cuttings with exception [illegible].

[illegible] from [illegible] sound to-day in [illegible] of Calimyrna [illegible] 8, [illegible] yesterday, placed in sand [illegible] fine [illegible] in the propagating frame.

Photographs

Kalmia plants
Budded blueberry
Vaccinium macrocarpon
[illegible]
27-inch plant.
[illegible] bud, natural size
[illegible] plant
[illegible] leaf [illegible] plant Cutler 111
[illegible] plant " 108
One year [illegible] plant
Stem [illegible] size [illegible]
[illegible]

[illegible] 1
Cutler 77 nat. size [illegible]
" 134 " " " Kalmia
~~213 [illegible]~~
[illegible] 1/3 [illegible]
[illegible]
[illegible]

[illegible] Nov. [illegible] 1931

[illegible]

Nov. 5 [illegible]

[illegible]

[illegible]

[illegible]

Nov. 2.

[illegible] [illegible]

[illegible] 132 [illegible] ([illegible])

[illegible] [illegible] ([illegible])

56 [illegible] ([illegible])

213 [illegible] [illegible]

Coldframes

Nov. 3.

Coldframe

Nov. 4. 97

Culture 227. Twenty five root cuttings from the Brooks bush, received yesterday, placed to-day in white sand in a box drained with sphagnum peat, and set in the outside ~~of the~~ propagating frame.

Culture 228. Fifty root cuttings from the Brooks bush, received yesterday placed to-day in yellow sand from the propagating house in a frame, drained with sphagnum peat and set in the outside propagating frame.

Nov. 5. 97.

Culture 229. Twenty-five root cuttings from the Brooks bush, received Nov. 3, placed to-day in leaf mold and sphagnum peat, with ~~sphag~~ in a box in a frame, in the propagating house.

Nov. 4, 1909

Culture 222. Six twig cuttings from the Brooks bush received yesterday, placed in yellow sand under a bell jar in the propagating house to-day.

Culture 223 Thirteen root cuttings about 1 inch long by [illegible] inch thick, from the Brooks bush received yesterday [etc as in Culture 222]

Culture 224 Ten twig ~~stem~~ cuttings from the Brooks bush received yesterday, placed in white sand in the propagating frame to-day.

Culture 225 Forty-eight root cuttings from the Brooks bush received yesterday, placed in white sand in the propagating frame to-day.

Culture 226 Fifteen stem cuttings from the Brooks bush received yesterday, placed in a ~~[illegible]~~ frame filled with kalmia peat, drainage, and put in the [illegible] propagating frame

Nov. 8, 1909.

In regard to the maintenance of acidity in blueberry soils the influence of an annually renewed surface supply of freshly killed organic matter should be considered. The thorough decomposition of organic matter, as in the Bissett leaf mold, produces a neutral soil. May not a surface layer of dead leaves produce in the early stages of decomposition ~~[illegible]~~ a soil moisture solution of ~~sufficient~~ acid~~ity~~ ~~to~~ reaction which, percolating through the underlying layers of older and partially decomposed leaves maintains them also in a condition of acidity and stops their ~~further~~ decomposition ~~before it~~ reaches the neutral stage? And are not oak leaves, perhaps because of their tannic acid, parti-

Nov. [illegible]

Culture 193. [illegible] [illegible] [illegible] [illegible] some of the [illegible]

Culture 207. Four [illegible] cuttings [illegible] [illegible], not callused

Culture [illegible]. [illegible] cutting taken up [illegible] to-day. [illegible] [illegible] [illegible] [illegible]

Culture 205. [illegible] [illegible] taken up to-day. B[illegible] have [illegible] through the [illegible] [illegible] the [illegible] beneath the [illegible]

Culture 204. [illegible] cutting taken up to-day. [illegible] [illegible] [illegible]

Culture [illegible] [illegible] cutting [illegible] [illegible] [illegible] [illegible], [illegible] [illegible].

Culture 176. Three cuttings the [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible]. Three other cuttings [illegible] [illegible] [illegible] [illegible].

Culture 200. Six two cuttings taken out to-day [illegible] [illegible]. All calloused. Three [illegible] [illegible] still green [illegible] in bed.
No. 3 cut [illegible] [illegible] sprouts above ground. [illegible] [illegible] [illegible] of ground [illegible] [illegible] [illegible] with the [illegible] [illegible] 1 mm long, [illegible] and [illegible] [illegible] but not sprouted.

Culture 199. ~~Three~~ cuttings brown and [illegible] [illegible]. ~~They~~ Two have a small callus, one a large one. Two are still green at the tip, having died from the base upward.

Culture 213. Bud of the stock [illegible], rubbed off with the idea of forcing the budded bud if practicable.

Culture 220. Asparagus. Nineteen plants remaining, all of which appear to be growing. Most of them have [illegible] [illegible] leaves and the largest one has four [illegible] [illegible] [illegible] small.

Culture 211. Sixty five [illegible] living [illegible] in fresh condition [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

Culture 201. Eight [illegible] [illegible] living, in [illegible] [illegible] then growing.

Nov. 9, '09.

Azalea plants shipped from H. W. [illegible] ~~[illegible]~~ [illegible] [illegible] to the Department bear cylindrical balls on the roots ~~about~~ 4 to 5 inches long (high) and about 9 inches in diameter. The spread of the branches in some of the [illegible] [illegible] [illegible] nearly an inch [illegible] two feet. The [illegible] the material [illegible] [illegible] [illegible]

[illegible] a mixture of sand [illegible] [illegible]

The soil contains many [illegible] and [illegible] [illegible] plants of Polytrichum.

Culture M. [illegible] [illegible] [illegible] living [illegible] [illegible] [illegible] city in [illegible] [illegible].

[illegible] 2/10. One [illegible] [illegible] [illegible] [illegible] [illegible]. Sixty eight [illegible] [illegible] [illegible] [illegible], but in general [illegible] [illegible] [illegible] suggesting [illegible] [illegible] [illegible].

[illegible] 11. [illegible] second [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

19[illegible] [illegible] [illegible] [illegible] of the [illegible].

Nov 17 1909

[illegible] ½

Nov. 17, 1909.

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~~Hope~~.

Culture 230. Seven plants from Culture 198, transplanted to an eight inch pan in coarse-sifted kalmia peat 9, fine-sifted [illegible] 1. Plants about .5 to 1 cm high, with 3 to 4 leaves. House no. 1 about 60 [illegible] at night

Culture 231. Seven plants from Culture 198, transplanted to an eight inch pan in coarse-sifted kalmia peat 10. Plants 4 to 5-leaved, averaging a little [illegible] those of Culture 230. House no. 1, about 60 to 65 at night.

Culture 198. Five plants all that are left after taking out 230 and 231 [illegible] transplanted to an eight inch pan in coarse-sifted kalmia peat [illegible]. Plants 3 to 5-leaved. House no. 1, about 60 to 65 at night.

Culture 197. The cutting potted on Oct. 8 [illegible] callus but no root, is [illegible] with a [illegible] except the tip. Discarded. This leaves only [illegible] cuttings rooted from 197.

Culture [illegible] 8. One of the root [illegible] 2 [illegible] out of the sand. [illegible] Only [illegible] mm. above the surface. [illegible] [illegible] things now alive

Nov. 8

Cutting [illegible] Dead [illegible]

Cutting [illegible] from cuttings [illegible]

Large [illegible]

[illegible]

[illegible]

Cutting [illegible] whole [illegible]

[illegible]

[illegible] in the [illegible]. To go [illegible] cold house.

Cutting 233. Seven plants from Cutting 173 transplanted to a pan in four inches [illegible] pot. Plants [illegible] 20 mm [illegible]. To go in cold house.

Cutting 232. Seven plants from Cutting [illegible] transplanted to a pan in [illegible]. Plants 7 [illegible] mm [illegible] foliage leaves. To go in cold house.

Cutting 234 Seven [illegible] from Cutting 173 [illegible] from Cutting [illegible] mm high, [illegible] To go in cold house [illegible] 4 [illegible] 6 foliage leaves.

Cuttings 235 Eight cuttings from 176, [illegible] to bring [illegible] pots, [illegible]
to go in cold house. [illegible]
~~not~~ enough! Others made [illegible]
made some time ago [illegible]

Cuttings 100. Taken out of thumb pots in the [illegible] and potted in 4-inch pot, with [illegible] in peat 9, sand 1. Leaves [illegible] [illegible] To go ~~back in~~ ~~out~~ [illegible]

Cuttings 236 Nine ~~ft~~ small cuttings from 176, potted today in 4-inch pots, peat 9, sand 1, [illegible] Three only have [illegible] leaves.

Cuttings 196. [illegible] Remaining eight of cuttings 235 + 236. Put [illegible] in the propagating frame [illegible] with [illegible]

G. & G.

Nov. 8, 19[illegible]

Cutin 197. ~~[illegible]~~ 198 The cuttings of this number taken out of the propagating frame to-day. One without shoot, but callused and alive, thrown away. Remaining seven potted in peat 9 sand 1, 2-inch pots. To go in cold house.

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Experiments in Blueberry Culture.

In the grounds of the Smithsonian Institution at Washington are two blueberry bushes* of large size and great age. The taller is about [illegible] (nine feet) in height. The largest stem is [illegible] ([illegible] inches) in diameter. It is known that these bushes were growing prior to 1871, 38 years ago, (?) and all the evidence in [illegible] is that they ~~[illegible] to the early planting~~ were planted at a much earlier date. They ~~[illegible]~~ [illegible] over 50 years ago.* In the [illegible]

---

* The plants are the [illegible] atrococcum, [illegible] to [illegible] corymbosum, the [illegible] known swamp [illegible] bush blueberry of the north [illegible]. In a list of the trees and shrubs of the [illegible] grounds prepared by Arthur S[illegible] (over)

[illegible]

[illegible] Georg[illegible] [illegible]

[illegible] that

these [illegible]

[illegible], in 187[illegible]. [illegible]

?

[illegible]

[illegible]. It is possible

[illegible] may have been

[illegible] as [illegible] as 1878, [illegible]

[illegible] the [illegible]

[illegible] made, by

[illegible]

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boretum near Boston are many blueberry bushes 5 feet or more in height, grown from the seed by Mr. Jackson Dawson. The seed [illegible] of these plants were [illegible] in 18 and are now [illegible] years old. The two cases [illegible] cited demonstrate the fallacy of the popular idea that the blueberry cannot be trans-planted or cultivated. And if they can be grown as ornamental plants why [illegible] not be grown successfully for their fruit?

Four agricultural experiment sta-tions, those in Maine, Rhode Island, New York and Michigan, have attempted to grow the blueberry as a fruit, but none of these attempts has resulted in commercial or even experimental success.

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That the market would ~~welcome~~ gladly pay a high price for a cultivated ~~they~~ blueberry of superior quality there can be no doubt. In the Boston market there is a wide difference in the wholesale price of blueberries. Shipments begin in early June ~~with~~ from North Carolina, followed in the latter part of the month by berries from Pennsylvania, ~~and~~ New Jersey, and New York. In early July, or in some years in the last days of June, Massachusetts and New Hampshire shipments begin to arrive, succeeded in late July or early August by berries from Maine, Nova Scotia, and New Brunswick. Receipts from these last two localities continue until late September. The blueberries that bring the highest price are those from Mass.

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chusetts and New Hampshire. At the time when other berries are selling at ~~8 to~~ 15 cents per quart wholesale, the first shipments of New Hampshire ~~berries~~ of fruit bring 20 to 23 cents.

The owner of a blueberry pasture in southern New Hampshire who superintended the picking of his own berries and shipped them ~~to~~ one of the secondary New England cities, has courteously shown his shipment records, from which the following ~~information~~ data have been compiled.

Year	Dates of shipment	Total shipments (quarts)	Range of prices (cents per quart)	Average net price
1905	July 11 to August 15	2233	12 to 8	10.7
1906	July 15 to August [illegible]	2756	15 to [illegible]	9.6
1907	July 20 to August 15	[illegible]	14 to 11	12.2
1908	June 29 to August 15	3602	16 to 9½	10.8
1909	July 15 to August 16	1255	14 to 9	10.7

~~This is the net price that the shipper received, by the shipper after deducting express charges.~~

The average net price for the five years was 10.8 cents per quart.

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This record indicates the substantial returns that are secured from ordinary wild berries picked and marketed in rather better than ordinary condition.

~~The qualities desired in a blueberry, from the market standpoint~~

From the market standpoint the features of superiority in a blueberry are large size; light blue color, due to the presence of a dense bloom over the purple or almost black skin; plumpness, that is, freedom from the withering or wrinkled appearance that they begin to acquire several days after picking. ~~been picked a few~~

dryness, or freedom from superficial moisture, especially the fermenting juice of broken berries, and

While the connoisseur in blueberries, who picks his own fruit, knows the widely ranging flavors in the berries of particular bushes, the buyer in the city market is content to select his fruit according to its appearance, knowing that the flavor will be good enough in any event. The size

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of the seed gives the buyer in the New England markets very little concern, for there the name blueberry is restricted to plants of the genus Vaccinium, all of which have seeds so small as to be unnoticeable when the berry is eaten, while the name huckleberry is applied with nearly the same precision to the species of the genus Gaylussacia in which the seed is surrounded by a bony covering like a minute peach pit, that crackles loudly between the teeth. In southern cities the fruits of both Vaccinium and Gaylussacia ~~by the~~ are called huckleberries, and it is probable that the low estimation in which the fruit of Vaccinium is there ~~held~~ is due to the lack of a distinctive popular name. To distinguish them by their appearance is difficult for an expert for some of the blueberries, or species of Vaccinium, are black, and some of the huckleberries are blue, ~~particularly~~ notably Gaylussacia ~~frondosa~~

* while huckleberries are mostly black and blueberries mostly blue

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a species often abundant in the sandy soils of the Atlantic coastal plain, which has a large fair berry of beautiful light blue color and possibly ~~[illegible]~~ flavor, but the miserable crunching ~~[illegible]~~ seed pits characteristic of ~~that other huckleberry~~ ~~its immediate~~ botanical ~~relatives~~, with its seeds the rough grit [illegible]

The berry ~~[illegible]~~ most is so well adapted to shipment as [illegible] than most other berries that, with good handling, it should reach the market in very ~~[illegible]~~ first-class condition. But its poor shipping qualities are often abused and the fruit ~~[illegible]~~ [illegible] is exposed for sale badly crushed, the berries covered with oozing juice and made dirtier [illegible] by the presence of dust. ~~Usually the [illegible]~~

This is the prevailing condition of blueberries and huckleberries in the markets of Washington, in striking contrast with the [illegible] cleanly ~~[illegible]~~ [illegible] berries of the Boston market. This bad condition is due usually to imperfect picking. The small size of the blueberry compared with other berries renders the picking of it expensive. The owners of

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blueberry pastures commonly ~~usually~~ pay ~~their pickers~~ two-thirds the net price of the berries to their pickers.

In order to reduce the cost of picking, various devices have been employed. The most widely used of these devices ~~[illegible]~~ is an implement known as a blueberry rake, a scoop shaped somewhat like a deep dust pan provided ~~armed~~ in front with a series of long pointed ~~teeth~~ fingers of heavy wire. With this implement in the blueberry canning districts of Maine, an ordinary picker, if expert, gathers to bushels per day, for which he receives about cent per quart. Blueberries can be picked with a rake at about a fourth or a fifth the cost of picking by hand. For this reason many of the berries that go to market are picked with a rake and it is these berries which, broken and fermenting, make up the greater part of the low grade

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stock so offensive to the eye and the taste. Blueberries intended for the market should never be picked with a rake.

~~F~~ What has been said regarding the high cost of picking ordinary blueberries by hand indicates the importance of securing a berry of large size if the fruit is to be cultivated. Large size and abundance means a great reduction in the cost of picking. Large size ~~It also~~ means also a higher market price and when taken in connection with good color and good market condition, it means a much higher price, ~~larger financial returns~~.

The ~~write~~ writer's interest was attracted to the subject of blueberry culture in 1906, in the autumn of which year some experiments were made for him by George W. Oliver to ascertain a suitable method of germinating the seeds. In the autumn of 1907 the cultural experiments ~~began~~.

New Hampshire

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In 1908 began experimentation ~~with~~ in the propagation of bushes bearing berries of large size, the most satisfactory of these being of a bush of the swamp blueberry, Vaccinium corymbosum ~~though not the largest~~ having berries a little more than half an inch in diameter. The largest berries tried, were from Oregon bushes of Vaccinium a little more than five eighths of an inch in diameter membranaceum. Except where otherwise stated, the experiments ~~to be~~ described in this paper were made with Vaccinium corymbosum. The principal results of the experiments are given under brief numbered statements, each followed by a detailed explanation.

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(Blueberry)

S[illegible]

[illegible]

[illegible] demand for a superior wild berry average price of [illegible] [illegible] Superiority of New [illegible]

[illegible] large size, pale blue [illegible]

[illegible] from [illegible] natural

[illegible]. Cost of picking (New Hampshire prices), [illegible]

[illegible] by use of [illegible] in [illegible]

district (price there), [illegible] [illegible] market, prices.

[illegible] must [illegible]

and [illegible] extensive [illegible] they must be [illegible]

[illegible] [illegible] 1906, [illegible]

[illegible]

for the [illegible] by Mr. George [illegible] to [illegible]

[illegible] method of germinating the seeds. In [illegible]

of 1907 the [illegible]

[illegible] may be briefly [illegible] as follows:

1. The swamp blueberry does not thrive in a rich garden soil of the ordinary type.

2. The swamp blueberry does not thrive in a [illegible]

soil [illegible]

3. [illegible] swamp [illegible]

soils by lime.

4. The swamp blueberry does not thrive [illegible]

5. The swamp blueberry does not thrive in a thoroughly [illegible] humus soil, such as has a neutral reaction [illegible]

Begin a new page in each new [illegible] [illegible]

~~4~~ 6. The swamp blueberry does not thrive in a soil having an alkaline reaction.

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For vigorous growth

7 ~~5~~. the swamp blueberry requires an acid soil.

8 ~~6~~. The ~~favorite type of~~ acid soil for the swamp blueberry is ~~acid~~ peat.

9 ~~7~~. ~~Acid~~ Peat ~~suit~~able for the swamp blueberry may be found either in peat bogs or ~~in~~ the surface of the ground in sandy oak ~~and~~ or pine woods.

10 ~~8~~. For active growth the swamp blueberry requires a well aerated soil. Conversely, the swamp blueberry does not continue in active growth ~~in a soils~~ ~~saturated~~ with water. saturated

11 ~~9~~. Aeration conditions satisfactory for blueberries are prevalent in sandy soils.

12 ~~10~~. Aeration conditions satisfactory for the swamp blueberry are found in drained fibrous peat.

13 ~~11~~. Aeration conditions satisfactory for the swamp blueberry are found in masses of ~~[illegible]~~ live moist but not submerged sphagnum.

14 ~~12~~. The swamp blueberry is devoid of root-hairs, the minute organs through which the ordinary plants of agriculture absorb their moisture and food.

15 ~~13~~. The rootlets ~~the~~ of the heath plants of the swamp blueberry ~~plant~~ are inhabited by a fungus, of the sort known tech-

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rically as an endotrophic mycorhiza.

16. ~~14~~ The mycorhizal fungus of the swamp blueberry appears to have a beneficial effect upon the blueberry plant.

~~15 The evidence at hand~~

17. ~~15.~~ The acid peaty soils in which the swamp blueberry thrives are deficient in available nitrogen, although containing large amounts of non-available nitrogen.

18. ~~16.~~ The deficiency of available nitrogen in the acid peaty soil~~s~~ in which the swamp blueberry ~~thrives~~ is due to the inability of the ~~[illegible]~~ nitrifying bacteria to thrive in such a soil~~s~~, because of ~~[illegible]~~ its acidity.

19. ~~17.~~ From the evidence at hand the presumption is that the mycorhizal fungus of the swamp blueberry transforms the non-available nitrogen of peaty soils into a form of nitrogen available for the nourishment of the blueberry plant.

20. ~~18.~~ From the evidence at hand the presumption is that the mycorhizal fungus of the swamp blueberry transforms the free nitrogen of the atmosphere into a form of nitrogen available for the nourishment of the blueberry plant.

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21. ~~19~~ Seedlings of the swamp blueberry are grown readily by proper treatment. Seeds sown in August from fresh berries germinated in about six weeks and after passing the winter in a greenhouse produced seedlings which ~~plants~~ grew into robust plants of a maximum height, at twelve months from germination, of 27 inches.

~~20 The swamp blueberry may be propagated by grafting, by budding, by layering, and by cuttings.~~

22. ~~20~~ Seedlings of the swamp blueberry carried through the first winter in the greenhouse have shown from to per cent of fruiting plants at two years of age. Occasionally a plant flowers at one year of age.

23. ~~21~~ The swamp blueberry may be propagated by grafting, by budding, by layering, and by twig cuttings.

24. ~~22~~ The most satisfactory method of propagating the swamp blueberry is by cuttings.

25. ~~23~~ Experiments have been begun on the field culture of the swamp blueberry.

whether with wild plants, or with seedlings, or with plants grown from cuttings,

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To those desiring to experiment with the field culture of the swamp blueberry, whether with wild plants, or with seedlings, or with plants grown from cuttings, two modes of treatment are suggested, both derived from the experiments already made. The first method, suited to upland ~~soils, is~~ is to set the plants ~~early in spring~~ in trenches or separate holes in well rotted peat a foot in depth and mulch the surface well, either with leaves or preferably with clean sand. The excavations should ~~be not less than~~ provide ample space for new growth of the roots, not ~~a foot in depth~~ less than a foot each way from the surface of the old root ball. The peat used ~~should be of the character~~ may be of either the bog or upland type, as described on pages to of this report, and preferably should have been rotted for several months before using. If only fresh peat is available the addition of one

The reason for adding the manure is discussed on pages to .

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tenth part, by bulk, of well rotted cow manure is recommended. This should be very thoroughly comminuted and mixed with the peat. The soil in which the holes or trenches are situated should be such as to provide good drainage, the ideal condition of the peat about the roots of the plant being one of continued moisture during the growing season, but with ? all the free water draining away readily so that thorough aeration of the mass of peat is ~~insured~~. If the surrounding soil is sufficiently porous ~~such~~ a moisture and aeration condition ~~can be maintained~~ without the necessity of mixing sand with the peat, better growth it is believed, will be secured than when such mixture is used.

The second method ... peat ... to ... out the plants in

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and deeply mulched with sand. The [illegible] employed in cranberry culture [illegible] improved [illegible] made for [illegible] winter. [illegible] is usual with [illegible]. This method of culture is suggested [illegible] because of the close botanical [illegible] of the swamp blueberry and the [illegible] bog, and the [illegible] physiological requirements in the [illegible] moisture, as well as the pres[illegible] [illegible] a mycorrhiza [illegible] roots of both, [illegible] the most [illegible] in all [illegible] the [illegible] occurred when [illegible] plants were feeding on pure peat and the [illegible]

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grown from a [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] regardless of [illegible] [illegible], as the fruits of our [illegible] [illegible] [illegible] [illegible] [illegible] it is not ex- [illegible] [illegible] the [illegible] fruit [illegible] [illegible] large, but [illegible] [illegible] [illegible] half inch [illegible] the fruit. No [illegible] cuttings are yet [illegible] for distribution.

[illegible] 1
[illegible]

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1. The swamp blueberry does not thrive in a rich garden soil of the ordinary type.

Although the statement you make might well rest on the direct observation of [illegible] experimenters who have failed to make blueberries grow [illegible], or sometimes even [illegible], in ~~rich~~ garden soils, nevertheless the [illegible] of the writer's experiments [illegible]. The [illegible] soil chosen for the [illegible] was the one made at ~~[illegible]~~ ~~[illegible]~~ the [illegible] of this [illegible] growing [illegible]. A [illegible] soil, as [illegible] by the [illegible], consisted of [illegible] shovelfuls of loam, one shovelful of [illegible],

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and a handful of lime". The loam used was a rotting grass turf grown on a rather clayey soil. The cow manure was well rotted, having lain in the pile for several months, with almost no admixture of straw. The lime was of the ordinary unslaked sort.

The pots used in the experiment were of glass, ordinary 5-ounce whiskey glasses, about 2 inches in diameter at the bottom, 2 1/2 at the top, and 2 3/4 inches deep. A small hole bored through the bottom gave the necessary drainage to the soil in the pot. Since the walls of these pots were transparent, the normal growth of the ~~green~~ roots and the prevention of an obscuring growth of microscopic algae required some arrangement for keeping light away.

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No ¶

This was accomplished either by burying, or, as gardeners say, "plunging", the pots nearly to the rim in sand, moss, or soil, or, when the pots were not plunged, by fitting closely to the outside of each a removable cuff, as it were, made of the ~~gray~~ opaque gray blotting paper used in pressing specimens of plants. The use of a pot with transparent walls was found to be of very great importance in the study of these plants, for plants identical in appearance so far as the parts above ground were concerned sometimes showed the most pronounced differences in the growth and behavior of the roots, differences which would otherwise not have been observed but which were in reality responsible for the ~~that were followed~~ ~~ultimately~~ ~~by~~ conspicuous changes that later took place in the growth of the ~~parts above ground~~ shoots. The use of such glass pots, drained and darkened,

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is strongly recommended to plant experimenters who use pot cultures, ~~for they will then be able to~~ as a means of ~~acquiring~~ acquiring easily an intimate knowledge of the great variations in the behavior of the feeding organs, the roots, under different conditions.

On December 22, 1908, six glass pots were filled with the garden soil described above, ~~a mixture of humus, sand and lime~~, and a seedling blueberry about an inch in height was transplanted into each. The seed bed from which the seedlings were taken had been allowed to become partially dry before the transplanting was done. In this condition there was no difficulty in removing all of the sandy soil adhering to the roots of a seedling, so that after transplanting the plant must derive its soil nourishment from the ~~new~~ soil exclusively. In potting, the roots of the plant were laid against the glass on one side of

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the pot so that their behaviour could be observed from the very first.

A transplanting of six other plants was then made, similar in all respects to the first except that the soil used was a peaty one known from earlier experiments to be productive of vigorous growth in blueberry plants. The exact character of this soil will be discussed later in this publication.

Now this peaty blueberry soil is ill suited to the growth of ordinary plants, while in the garden soil ordinary plants flourish luxuriantly. In order to bring out this fact six glass pots containing this garden soil were planted with five alfalfa seeds each, and six more with one rooted rose cutting each. An identical planting was made in twelve pots of blueberry soil.

Average examples of the growth that took place in these plantings are shown in Plates 1, 2, and 3. In the garden soil the rooted rose

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cutting, which was of the variety
known as Cardinal, made vig-
orous growth of both root and stem,
and in 44 days, when the photo-
graph was taken, had about quad-
rupled its leaf surface. In the
blueberry soil the cutting was barely
alive, the roots it had at the time it
was potted were nearly all dead, the
leaflets it bore were only those still
persisting from the parent plant.
no new stem growth had been
made, and

The alfalfa seeds began to germin-
ate in both soils in three days. At
the end of a week a distinct difference in
the color of the plants was discernible.
In the blueberry soil the seed leaves were
notably darker green in color, the mid
rib, which shows on the back of the leaf

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was purple, the stem was purple, and in some of the seed leaves the whole under surface was purple. In the garden soil the seed leaves were notably lighter green in color, and in only a few were the stems, and in still fewer the midribs, somewhat purplish. At the end of 44 days, when the photographs reproduced in Plate 2 were taken, the alfalfa plants in the garden soil were three inches in height and vigorous, while the soil was crowded with roots on which nitrogen tubercles had already begun to develop. In the blueberry soil the plants were small leaved and sickly, about a third the height of the others, and the roots though long were slender and otherwise weak, and bore no tubercles.

With the blueberry plants the relative growth in the two soils took exactly the oppo-

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site course. At the end of the first week new root growth had taken place in all the pots containing blueberry soil while in those containing garden soil new root growth was apparent in only one. At the end of 44 days vigorous root growth had taken place in the blueberry soil pots, and stem growth, which had been interrupted at the time of the transplanting, was well under way. In the garden soil, however, almost no root growth was discernible, the old leaves were strongly purpled, and stem and leaf growth had not been resumed at all. Little attention was paid to these cultures during the summer of 1909 but the relative condition of the two is fairly illustrated in Plate 3 from photographs taken November , 1909, after the leaves had fallen. The garden soil pot contained only a few

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stray roots, and the slender stems were only
? inches high. The pot containing
blueberry soil was filled with a mass
of roots, ~~and~~ the largest stem was
? inches long, and the weight of
? ~~that~~ part of the plant above ground was
times that of the corresponding part
of the garden soil plant.

Nov. [illegible]

[illegible]. Four concrete bins have been constructed at [illegible] each 6 feet square inside and about four feet high, the bottom of the bins being the natural soil. The object is to ascertain the character of the [illegible] produced by rotting [illegible].

The south bin [illegible] [illegible] ton [illegible]. The [illegible]

The north bin (No. [illegible]) was filled with [illegible] wagon boxes full of oak leaves mostly [illegible] with [illegible], alba, [illegible] and [illegible], and [illegible]. [illegible] was sprinkled over the leaves as they were put in and a hose was played on the leaves, and the [illegible] [illegible] pounds [illegible] wagon [illegible]

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2. The swamp blueberry does not thrive in a heavily manured soil.

In May 1908, two healthy and vigorous blueberry seedlings were sent for trial to one of the agricultural experiment stations. They were set out in a soil that was known to be suitable for these plants, for old blueberry bushes had been growing there for several years. The man who put the blueberry seedlings in the ground, however, misunderstanding the directions sent him, filled the holes in which he set the plants with alternate layers of soil and well rotted stable manure. The writer examining the plants in August 27, 1909, when they should have been either growing vigorously or, with mature

foliage, ripening their wood for the winter.
Instead they had lost nearly all their
older leaves though still maintain-
ing a feeble and spindling growth
at the ends of the larger stems.
The adjacent old bushes growing in
receiving the same soil, except that ~~for~~
they had not received the ~~heavy~~ application of manure bore at the same time vigorous
dark green foliage and were ripen-
ing the wood of their stout twigs and
laying down their flowering buds for
the following year. ~~The contrast was~~
~~that of thoroughly healthy plants with~~
~~so manured and very sickly ones~~
~~when heavily manured.~~ The manured
plants when dug up and examined
showed no new root growth whatever
in the manured soil outside the old
earth ball, and most of the roots in
the surface of the ball itself were
dead. Another experiment may be cited ... the injurious effect of heavy manuring.
On ... 9, six blueberry

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Chief Clerk.

seedlings were transplanted into as many glass pots in a good blueberry soil, and six other seedlings were potted in the same manner except that to each two parts of blueberry soil one part of well rotted [illegible] manure was added. at first ~~for the first three weeks after~~ ~~potting~~ the manured plants differed superficially, [illegible] being better than those not manured, for in the former the production of new leaves and the continued growth of the stem tip was not interrupted by the potting, while in the plants not manured there was a temporary but [illegible] stopping of stem growth immediately after the potting. The apparent superiority of growth in the manured plants, always [illegible], continued for about three weeks. Meanwhile the [illegible] two cultures [illegible] been [illegible] long in a very

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diverse manner. In the plants without ammonia new root growth began a few days after potting; at the end of three weeks the development of an extensive root system was well under way, and the plants ~~were~~ were nearly ready for a period of vigorous stem growth. In the ammonia plants, however, either no root growth at all took place, or only a slight amount, the new rootlets being fewer, shorter, and stouter than in normal plants. The old rootlets turned brown and appeared to be dead or dying. At the end of five weeks the top growth was very slow.

About ten days after, on February 6, a bright warm day, the lower leaves on these plants wilted, ~~[illegible]~~ and within a few weeks all ~~[illegible]~~ size of the ~~[illegible]~~ ammonia plants were dead.

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Nov. 22, 1909.

Culture 195. A few seeds still germinating.

Cultures 73, 77. Stems of the two plants photographed to-day were cut off and weighed, green, as follows

2.217 grams, blueberry soil stem (Culture 73)

.043 grams, rose-forcing soil stem (Culture 77)

~~43) 2217 (51.5~~
~~215~~
~~67~~
~~43~~

Length of stems
Blueberry soil plant (Culture 73)

Stem 4	28.5 cm
3	21
2	13
1	4
	66.5

Rose soil plant (Culture 77)

Stem 2	5.3
1	3.7
	9.0

9) 66.5
7.4 sq. = 54.2

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Nov. 23, 1909

Cutler 130. Lime water bottle as ordinarily [illegible] 2.4 liters. [illegible] as follows.

	Mar.		Aug
1	10-	26	[illegible]
2	23-	27	[illegible]
	Apr.		Sep.
3	-22	[illegible]	2-
	May		
4	-1	[illegible]	8-
		[illegible]	1[illegible]-
5	3-	[illegible]	2-
6	8-15	[illegible]	[illegible]
7	23-	[illegible]	4-
	June		
8	[illegible]10	3-	12. 22
9	12-		
10	17-		
[illegible]	[illegible]		
[illegible]	2[illegible]		
[illegible]	[illegible]		
13	25-		
	July		
[illegible]	1-		
15	[illegible]		
16	7-		
17	9-		
[illegible]	[illegible]		
[illegible]	[illegible]		
20	[illegible]		
[illegible]	[illegible]		
	Aug.		
22	[illegible]		
23	8		
2[illegible]	[illegible]		
2[illegible]	17-		

One plant destroyed about Sept. 25.

Calcium oxid about 1.25 grams per liter

Estimate that a third the lime water went through the [illegible], a liberal estimate.

31 number bottles on 6 plants
2.4 liters per bottle
124
62
74.4 liters on 6 plants
3) 24.8 liters run through
50 liters leaving lime on 6 plants.
1.25 lime per liter, grams
6) 62.5 grams lime on 6 plants
10.4 grams lime on 1 plant to Sept. 27

3 bottles on 5 plants
2.4 liters per bottle
7.2 liters on 5 plants
3) 2.6 liters run through
5) [illegible] liters leaving lime on 5 plants
1 liters
1.25 grams lime on 1 plant after Sept. 27.
10.4 " " " " before
12 grams lime on 1 plant Mar. 10 to Nov. 2[illegible]

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Culture 30
Height 10 inches
17 1/4 (17 1/4)
11 1/4
16
16

$5 \overline{) 70.5}$
14. inches, average height

Nov. 24, 1909

Culture 130. Experiment made to-day in putting lime water through the most impervious pot. 50 cc. lime water poured into pot. Began to go through in about one minute. Phenolthalein added, did not redden. Boiled, turned pink. Nearly 50 cc. came through altogether. All turned a light pink.

One pot, the smallest plant, turned over to Mr. Brazeale for determining the total lime, to see how this compares with the amount estimated from the watering. In this pot appeared essentially the same phenomenon as in the others, namely a lime crust a millimeter or less in thickness, below about half an inch of black, rootless soil and down the label the same black rootless line.

About an inch of [illegible] this [illegible]
[illegible]

Nov. 24 1899

Cutting 233. Tip of central one eaten off by [illegible], none of others are [illegible]

Cutting 234. Tip of [illegible] [illegible], eaten off [illegible] some, none of others [illegible].

Experiment in propagation of blackberries.
Cut off plant and let ~~young~~ new shoots arise from the stumps. Then fill in with a foot or so of sphagnum. Keep moist but not wet so that adventitious roots will be ~~[illegible]~~ formed if possible. In the winter following the formation of the roots cut off the stems.

[illegible] 221, [illegible]

[illegible]

[illegible] 180, [illegible]

[illegible]

[illegible] No [illegible]

[illegible] 112, [illegible]

two [illegible]

[illegible] Four [illegible]

with a [illegible]

[illegible]

[illegible] 12 [illegible]

[illegible]

Three near [illegible]

[illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

~~[illegible]~~ [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] follows. [illegible] [illegible]

[illegible]. 360 mm.

370

360

370

420

285

[illegible]

230 [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] Two [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] before cutting back.

3[illegible]0

385

350

380

430

375.

[illegible] [illegible] [illegible] back [illegible] by [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

Nov. 28 [illegible]

Cutting 208 One [illegible] ~~[illegible]~~ [illegible] left [illegible] the base having been [illegible] today.

Cutting 177. At least eight of the cuttings are dying, showing ~~[illegible]~~ dead tissue near the surface of the [illegible] soil beneath.

Cutting 64 + 64 A. [illegible] several [illegible] [illegible] culture, in the cold frame with some heat on, the [illegible] beginning to [illegible]

Kalmia latifolia in the cold frame no growth, [illegible] leaves [illegible] [illegible] leaves [illegible] are somewhat [illegible] [illegible] [illegible] and brown from [illegible]

[illegible] [illegible]. Not ~~[illegible]~~ improving [illegible] [illegible] of the cold frame.

[illegible] 1 1 1

Potted by Miss Burns several [illegible] [illegible] in 5 inch pots, [illegible] 3[illegible] [illegible], in [illegible]

Pages 1 to 12 copied Nov. 27, 1907

3. The swamp blueberry does not thrive in a soil made sweet by lime.

In its natural distribution the blueberry, like almost all plants of the blueberry and heather families, avoids limestone soils. The fertile limestone areas of western New York, of Ohio, of Kentucky, of Tennessee, lack the blueberry, the huckleberry, the [illegible] (Kalmia latifolia), the trailing arbutus (Epigaea repens). The [illegible] of [illegible], as [illegible] by Charles Mohr in volume 6 of Contributions from the United States National Herbarium, is traversed from east to west by a strip of dark calcareous soil, ~~The belt, which lies the vicinity of Montgomery, has a width of~~ 35 to 40 miles in width, the so-called "black belt", which constitutes the great agricultural [illegible] of the state. ~~The~~ non calcareous areas

in the [illegible] belt & Montgomery

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....

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....
Chief Clerk.

north and south of this strip have in their forests a characteristic undergrowth of blueberries and closely related plants, including huckleberries, farkleberries, and deerberries.

In the the intermediate belt of black limestone soil just described the plants of the blueberry ~~and heath~~ relationship are almost wholly wanting. ~~by Mr. M. L. Fernald~~

In an article entitled "The soil preferences of certain alpine and subalpine plants", published in 1907 (Rhodora 9: 149-193), Mr. M. L. Fernald discusses the natural distribution of over two hundred and fifty species of plants found in the cold parts of the northeastern United States and Canada. All the blueberries he enumerates, five species, avoided calcareous soils, and the other ~~species~~ plants of the blueberry and heather families, almost without exception, likewise occurred on non-calcareous formations.

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Very respectfully,

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The writers own experiments in growing blueberries in limed soils have not proceeded with the same smoothness as some of his other experiments, but the results though at first misleading have always been remarkable and in the end exceedingly instructive, though not always in the direction originally contemplated.

On May 26, [illegible], six blueberry seedlings were potted in six 14-ounce drinking glasses in a good peaty blueberry soil, in which however one per cent of airslaked lime had been mixed immediately before the potting was done. Six other plants were simultaneously potted but without the addition of lime. The unlimed plants grew normally. The younger leaves of the limed plants, however, began to wilt the same day. On June 1 all the leaves on all the plants were withered, though parts of the stems were still green and plump. The

(over)

during the first few days, but the plants
subsequently recovered and made
as good growth as could have been ex-
pected from the general character

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of their soil.

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did not turn purplish or yellowish as

for is usual with sickly, blooming plants,

but either retained their green

color after withering or turned brown.

and deliver the same at ....

No new root growth took place

in any of the lower parts, and by

Very respectfully,

July 10 all the plants were dead.

~~By accident~~ Another series of six

plants, also potted on May 26, 1908,

Chief Clerk.

but in a sterile soil containing no

peat, by accident ~~....~~ received a

very small amount of lime. Most of

the leaves on these plants withered

From these experiments ~~just described~~ the writer concluded that the blueberry was exceedingly sensitive to lime, that the slightest admixture of it in the soil would be immediately fatal to the life or at least the health of a blueberry plant. This conclusion, however, was erroneous, as subsequent experience showed. This first experiment may therefore be dismissed with the explanation that in all probability the immediate collapse of the plants was due to a caustic effect of the lime used. In none of the later lime experiments did this immediate collapse occur and in none was the lime so applied that it came into contact with the blueberry roots while in a caustic condition.

Still laboring under an erroneous conception of the super-sensitiveness of the blueberry plant to minute quantities of lime the writer, desiring to produce fresh examples of this phenomenon, in November, 1908, placed

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a very small quantity,
a few milligrams, of airslaked lime on the surface of the soil in each of three 2-inch pots containing a small blueberry plant. No effect was produced, either at first or for several weeks.

On December 19, 1908, a large surface application of carbonate of lime, a gram to each pot, was made and the lime was washed down with water. The expected collapse did not occur. The limed plants continued to grow as luxuriantly as their unlimed neighbors. The conclusion was reached that the reason why the ~~lime~~ growth of the plants had not been affected ~~the~~ was because the lime had not penetrated sufficiently into the soil. Another and more drastic experiment was therefore determined upon.

On March 19, 1909, six blueberry plants in 4-inch pots containing a good blueberry soil were set apart from

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Very respectfully,

____

Chief Clerk.

their fellows and watered with ordinary limewater, a saturated solution of calcium oxid (1.25 grams per liter of water). The applications made were of such an amount that the soil in the pot was thoroughly wetted each time, and usually a small excess quantity ran through the hole in the bottom of the pot.

For more than seven months, until October 22, 1901, these pots received no other water than limewater. During this period the plants continued to grow in a normal manner, their average height increasing from 4½ inches to 14 inches. The lime appears to have no deleterious effect whatever on the growth of the plants. An analysis of the soil in one of the pots, (after the limewater applications had ceased) showed that the amount of lime it carried was enormous, considered from the standpoint of ordinary agricultural

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Very respectfully,

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Passage. The soil was per cent lime, ~~After allowing a liberal allowance of one third for limewater wasted by running out at the bottom of the pot immediately after watering, the computation showed that each pot must have received about 12 grams of lime, or % of the dry weight of the soil. An actual chemical analysis of the contents of one of the pots after the limewater applications had terminated showed grams, or %, of lime.~~ This is the equivalent of about tons of lime per acre ~~for a soil having the specific gravity of the one used~~.

Now it was known from other experiments, to be described later, that in a soil containing as much as % of lime blueberry plants should either die or barely remain alive. As a matter of fact these limewater plants were making excellent growth. A careful examination was then made of the contents of one of the pots. The surface of the soil was covered with a hard gray crust of lime. Immediately underneath for a depth of about half an

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inch the soil was black and contained no live blueberry roots. There was a zone of the same black rootless soil along the wooden label that reached from top to bottom of the pot. In all other parts of the dark brown peaty soil there was a dense mass of heathy roots which reached down also into the open spaces among the broken crocks in the bottom of the pot. The lime appeared to have penetrated only into the superficial portions of the soil. A chemical test showed that the black rootless layer was densely impregnated with lime, while the brown peaty portion, containing the growing roots, still gave the acid reaction that was characteristic of the whole potful of soil before the limewater applications began.

Since all the water that the

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limeless, root bearing portion of the soil had received during the preceding seven months had come from the lime-water applications, it was evident that ~~the lime~~ contained in the limewater had been depos-ited in the upper layers of the soil. The ~~following~~ laboratory experiment confirmed this. ~~In an ordinary glass was placed a small quantity of the soil used in growing blueberries. Upon this was poured dilute limewater reddened by the addition of phenolphthalein, a substance that gives a delicate color test for lime. Within~~ A small quantity of the acid peaty soil used in growing blueberries was placed in a glass vessel and moistened. Then dilute limewater reddened by the addition of phenolphthalein, a substance giving a delicate color test for lime, was stirred into the soil and the mixture poured into an ordinary paper filter.

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The water came through the filter without a trace of red color, showed none after boiling, to drive off any possible carbonic acid, and when tested with ammonia and ammonium oxalate showed not a trace of lime. The precipitation of the lime had been complete and practically instantaneous. Only ten seconds had elapsed between the time when the limewater was added to the soil and the time when the liquid began to drip through the filter.

In order to ascertain whether a large part of the lime in the limewater used on the Klamile may not have passed through the pots by running down the partially open channel along the label, some ~~full strength~~ limewater was poured upon the surface of one of the pots. The excess water that

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~~came out~~ soon began to drip through the bottom of the pot was tested for lime. It was found that while the limewater poured into the pot contained .1014 per cent lime, the water that came through contained only .0046 per cent. In other words a pot of soil that for over seven months had been used essentially as a limewater filter still continued to extract over 95 per cent of the lime contained in the limewater ~~pa~~ that was passed through it, notwithstanding the fact that there was a partially open channel down one side of the pot. It is believed that had the soil been ~~firmly and~~ evenly compacted in the pot no lime whatever would have been able to pass through but that all would have been precipitated in the uppermost layers.

While this experiment has no important bearing on the subject of blue-

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berry culture it is of very great sig- 12
nificance in its bearing on the
method of applying lime to acid
soils in ordinary agricultural
practice. A surface application of
lime would have no apprecia-
ble effect in neutralizing the
acidity of a soil unless the
soil was so sandy or gravelly
or otherwise open that the rainwater containing
the dissolved lime could run down
through it practically without
obstruction. A surface
dressing of lime would have
little effect in neutralizing the
acidity of an old meadow or pasture.
To secure full action of the lime requires its
~~Only one~~ ~~in~~ intimate mixing ~~of the lime~~
with the soil such as can be ac-
complished by thorough harrowing, especially after ~~the use of a drill or~~
putting the lime beneath the surface
with a drill. ~~can produce the~~

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Add to page 8e Copied Nov. 30, 1909 13

Among the ~~soil mixtures~~ experiments with blueberry seedlings in different soil mixtures started on December 22, 1908, was one in which six plants were set in glass pots in a good blueberry soil to which ~~one~~ 1 per cent of carbonate of lime had been added. The first difference that showed between these and unlimed plants in the same soil was the much feebler root growth of the limed plants. This was followed by an evident tendency toward feebler stem growth. The later progress of this experiment was interrupted, however, and its average results vitiated because the roots of some of the limed plants found their way through the holes in the bottom of the pots and obtained nourishment from the unlimed material in which the pots were plunged. These plants made nearly as good growth as the unlimed plants. On November 27, 1909, there remained only one of the limed plants whose roots were all inside the pot. This

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plant was small and feeble, its stem
3 being only inches high. Its ~~con-
spicuous~~ inferiority to the unlimed plants
~~was~~ almost as conspicuous as that
7 of the garden soil plants described on
6e page and illustrated in Plate 3.

~~Use this matter, above, giving the "soil test" and "the test of the [illegible]" made by Mr. [illegible] on Monday showing the [illegible] to be non acid. It is [illegible]~~

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Nov 27 [illegible]

Culture 1334?[3] A large [illegible] from the [illegible] 120 [illegible], which [illegible] [illegible].
To-day [illegible] and [illegible] nearly [illegible].

Culture 120 [illegible] [illegible] the [illegible] [illegible] is [illegible] long [illegible]

Culture 209. The largest plant does not seem to be doing [illegible]. The uppermost [illegible] of 4.5 by 6 mm. is flesh colored toward the [illegible] and the leaf rudiment the [illegible] [illegible] is paler [illegible] [illegible] Thurisan of the smaller plants [illegible] [illegible] new growth.

May [illegible]

[illegible] cuttings [illegible]

[illegible] dead [illegible]

besides the two [illegible] out by

[illegible]

[illegible]

Desert Botanical Laboratory
of the
Carnegie Institution

[illegible] 1.1 Nov. 29 [illegible]

6	3[illegible]	[illegible]
$4\frac{3}{4}$	6	
5	$13\frac{3}{4}$	
$9\frac{3}{4}$	X [illegible]	$\boxed{7}\ \frac{3}{4}$
$5\frac{3}{4}$	$13\frac{1}{2}$	
$3[illegible]\frac{1}{4}$	9	
	$8\frac{1}{2}$	
	5	
	$7\frac{3}{4}$	
	$5\frac{3}{4}$	
	$3\frac{3}{4}$	
	$7\frac{1}{2}$	
	6	
	7 [illegible]	
	9 [illegible]	
	[illegible]	
	13 [illegible]	
	[illegible]	
	[illegible]	
	78 [illegible]	

[illegible]

$7\frac{3}{4}$ [illegible]

[illegible] X

[illegible]

Small package — 4.5384 ✓ [illegible]

	9
	13 3/4
	16
14	15 3/4
11 1/2	15 1/4
11 3/4	10
11	14
10 1/4	15 1/2
11	16 [illegible]
[illegible]	12 [illegible]
11	13 1/2
11 1/2	12 1/2
11	14 1/4
10 1/4	
9	
[illegible]	

[illegible]) 275 (11 [illegible]

[illegible]

11 [illegible]

G. & G.

[illegible]

12 [illegible]
6 [illegible]
[illegible]
[illegible]
12
[illegible]
[illegible]
[illegible]
2
4 [illegible]
4 [illegible]
6 [illegible]
1 [illegible]
10 3/4
11
12 3/4
~~[illegible]~~
~~[illegible]~~
[illegible] 1/2

[illegible] 1/2
10 [illegible]
10
5
13 [illegible]
14 [illegible]
12
14 3/4
15 1/4
13 [illegible]
13 3/4
14 1/2
12 [illegible]
14
9 1/2
12
3 1/2
5 1/2
[illegible]
[illegible]
13 1/2
[illegible] 1/2
9 3/4
[illegible]

[illegible]
13
9 1/2
10 3/4
7
15 [illegible]
4 3/4
10 1/2
14
11 [illegible]
10 [illegible]
[illegible]
12 [illegible]

[illegible]
12 [illegible]

[illegible]

[illegible]

8 1/[illegible]

7 [illegible]

5

7 [illegible]

6

5

6

7 [illegible]

5

1

7

6

4 1/4

7 1/2

4

5 1/4

6 [illegible]

7 1/2

4 1/4

6 3/4

4 1/4

5 1/[illegible]

7 [illegible]

8 3/[illegible]

4 1/[illegible]

6 [illegible]

[illegible]

G. & G.

108. measurements in inches

13 3/4
14 1/4
10 3/4
10 1/2
13 1/2
10
10 1/2
13 3/4
11
9 1/2
11 1/2
14 1/2
8 3/4
6 3/4
12 1/2
15
10 1/4
15 1/2
15 3/4
13 1/2
20 1/2
10
277 3/4

277 3/4
8 1/4
8 1/2
10 1/2
15 1/2
15
11 1/2
11 1/2
15 1/4
12
12 1/2
12 1/2
12
14
16 1/2
17 1/4
10 1/2
480 1/4

480 1/4
17 3/4
16 1/2
21
15 1/2
553

Average length
13 1/4 inches.

25.2330

Copied Nov. 30, 1909

5/ The swamp blueberry does not thrive in a thoroughly decomposed leaf mold, such as has a neutral reaction.

It had been found in earlier experiments that certain soils composed in part of imperfectly rotted oak leaves, were very good for growing blueberries. On the supposition that the more thoroughly rotted this material was the better suited it would be for blueberry growing, a quantity of old leaf mold was secured for an experiment. ~~the purpose~~ The mold ~~It~~ was black, mellow, and of fine texture. The mixed oak and maple leaves from which it was derived had been rotting for about five years, until all traces of leaf structure had disappeared. It was the same kind of black vegetable mold that forms in rich woods where trilliums, spring beauty, and bloodroot delight

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to grow.

On February 20, 1909, twenty-five blueberry seedling were potted in 3-inch clay pots in a mixture consisting of eight parts, by bulk, of the leaf mold just described, one part clean sand, and one part clayey loam derived from rotted grass turf. Fifty other plants were potted in the same manner except that in place of the mold was used a peat known from earlier experiments to be well suited to blueberry growing. The plants were kept in the greenhouse until warm weather when they were placed out doors. All were given the same treatment, a treatment favorable to good growth.

It had been expected that the plants in the leaf mold would show a vigorous growth, and it was hoped that the mold

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might prove even superior to the peat for blueberry soil mixtures. The experiment as it progressed, however, showed that such was not the case. The leaf mold proved to be not merely not a good soil for blueberries, but an extremely poor one, as the following particulars will show.

When the plants were potted they averaged about 2 1/2 ~~two and a half~~ inches in height. On May 29 the peat soil plants had an average height of 7 1/4 inches, while the leaf mold plants averaged 4 1/4. At this time the foliage of the leaf mold plants was decidedly purpled and yellowish, a coloration which it had taken on soon after the plants were potted and from which they never fully recovered. At the end of the season, after the leaves were shed, the peat soil plants averaged 13 1/4

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(over) inches in height, the leaf mold 4
? plants 7 3/4 inches. ¶ When these
plants were removed from their
original sand bed, to be trans-
planted to the 3-inch pots, such
of the original soil as clung to
their roots was not shaken off.
It is believed that the leaf mold
plants fed on this original soil in original part
making their new growth and
that without it they would have
shown still less increase in
height than they did. The peat
soil plants, moreover, were badly
in need of repotting, even in
early summer, and had they been
placed in larger pots the difference
in the growth of the plants in the two
soils would have been much greater
than it was.

That the influence of the leaf mold
was directly deleterious and that the

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On November 29, 1909, five average ~~representative~~ plants from each lot were cut off at the surface of the ground and weighed. The weight of the stems from the leaf mold plants was less than one fifth ~~that~~ from the plants in the good soil

poor growth of the blueberry plants
in it was not due to the lack of
some element that might have been
furnished by the addition of a small
amount of the good soil is shown
by certain intermediate experiments.
Along with the experiments described above
were carried two others in which
the soil mixtures contained both peat
and leaf mold. In the first, in which the
proportions were peat 5, mold 3,
sand 1, loam 1, the average height
of the plants on May 29 was 6 inches,
at the end of the season 12½ inches.
In the second lot, in which the pro-
portion was peat 3, mold 5, sand 1,
loam 1, the average height on May
29 was 4½ inches, at the end of the
season 11¾ inches. It will be
observed that these two lots of plants
are intermediate in their growth
between the first two and that in
all four lots — the poverty of

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growth is roughly ~~directly~~ proportional to the amount of leaf mold used in the soil.

That the weak growth of the plants in leaf mold was not ~~due to~~ caused by a compacting of the soil and a lack of aeration, due to too small a proportion of sand in the mixture, is shown by still another lot of twenty-five plants which were potted in a soil mixture ~~consisting in the~~ having the proportion mold 6, sand 3, loam 1. These plants averaged only 4 inches in height on May 29 and 6 1/4 inches at the end of the season. They grew even less, therefore, than the plants with only one part of sand and eight parts of mold.

The reason for the unexpected and remarkable deleterious quality

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of ~~the~~ leaf mold shown by ~~these~~ ex- 7
periments is given on page
and further discussed on

page

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Cuttings 157. Fourteen plants now alive and growing. One of them now has three of the small, smooth shining, glandular ciliate foliage leaves expanded. One of the earlier seedlings with white cotyledons has remained long stagnant, the cotyledons never having expanded. The growth of all the seedlings is slow after the cotyledons have expanded, the elaboration of starch with such a small chlorophyll surface evidently requiring much time and the growing energies of the plant being devoted chiefly to the development of an adequate root system.

Cuttings 198. No tips withered yet.

230 " " " "

231 " " " "

Cuttings 208. Last twig cutting dead. Only one root cutting with shoots alive [illegible]. Front four root cuttings taken up for examination and put back; all [illegible] to one [illegible] and alive; first one with shoots started; fourth [illegible] shoots started and a new root formed.

Nov. 30, 1917.

Cuttings -3, The two plants of 133 in the cold house repotted, the largest from 4 inch pots into 6-inch pots, fine coarse sifted Sphagnum peat, the larger of it with crocks, both with a ~~peat layer of~~ thick piece of fibrous Sphagnum peat at the bottom. Plunged in sand in the cold house,

Copied Dec. 1, 1909.

4. The swamp blueberry does not thrive in a heavy clay soil.

In its natural geographic distribution the blueberry shows an aversion to clay soils. Its favorite situations are swamps, or sandy lands, or peaty, often gravelly, loams. When a blueberry plant grows upon a clay soil it is usually found that its finer feeding roots rest in a layer of half rotten vegetable matter overlying the clay. Often in such situations the dense covering of interwoven rootlets and dark peatlike soil may be ripped from the surface in a layer no thicker than a door mat and of much the same texture. The roots of the blueberry do not penetrate freely into the underlying clay.

In greenhouse culture the blueberry shows the same aversion

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to clay soils.)

Various series of blueberry seedlings were potted on May 26, 1908, ~~in different~~ soils in ordinary large drinking glasses. For one set of six plants a stiff clayey soil was used, such as is common in the neighborhood of Washington. The surface of the soil in the glass was mulched to the depth of nearly an inch with half rotten leaves. In another six glasses were set six similar plants in a peat soil, the surface mulched in the same way as the others.

In other ~~[illegible]~~ experiments with this soil, in clay pots, the growth of the plants had always been poor. The present experiment was no exception. But the feature of greatest interest was the behavior of the roots. Plate 5 (over) shows the

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from a photograph taken October 5, 1908,

root systems of typical plants in the two soils. In the clay almost no root development took place, and in the illustration no roots whatever are visible, ~~in the clay~~. The interrupted black lines in the clay are tunnels made by animals. In the moist leaf mulch on top of the clay, however, the plant developed its roots extensively. Some of the plants, probably because they were set too deeply in the clay when the potting was done, failed to send their roots up into the mulch, and such plants were much inferior in their growth to those that found the mulch. In the other glass is shown the normal ~~root~~ growth of a blueberry in a soil it likes.

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Dec. 1, 1909.

The temperature in the budding tiny frame went just below 32° last night. There is still ice on the inside of the glass but the earth appears not to have been frozen.

The soil on the surface of the pots out doors froze last night. The sand between the pots did not freeze since the surface was dry, and only slightly even [illegible] the surface was moist.

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Dec. 1, 1909.

[at Indian Head, Northwest Territory]

"Ten bushes of huckleberries ~~[at Brandon, Manitoba]~~ were planted last spring".

A. Mackay, Canada Exper. Farms Rep. 1893: 303. 1894.

"Ten bushes of huckleberries were received from Iowa and planted [at Brandon, Manitoba] in 1893, all started to grow, but this fall only three were alive, these are not promising and will probably succumb during the present winter".

S. A. Bedford, Canada Exper. Farms Rep. 1894: 313. 1895.

Dec. 2, 1909

One lemon had 32 cc of juice.

Ten ounces = 320 cc., an ordinary lemonade glass.

~~Ordin~~

Lemon juice is just about a normal solution of citric acid, a normal solution requiring 6.4% of citric acid, ~~and~~ A Mediterranean lemon having about 7% ~~and~~ citric acid, a California lemon about 6%

Ordinary lemonade is about a 10% normal acid solution.

~~Diluted lemonade~~

Lemonade diluted ten times making a 1% normal solution is only faintly acid to the taste.

BPI

Dec [illegible],

Thermometer in the [illegible]
frame went to 3[illegible] degrees [illegible] light.
No [illegible] on the glass [illegible] noon

Dec. 3, 1937

Soil is air-dried at room temperature.

Weigh out 10 grams of the soil, dry weight.

Add 200 cc of hot water, shake thoroughly, and allow to stand over night (boil to drive off carbonic acid)

In morning filter ~~and~~ off 100 cc. and titrate with a 5% or $\frac{1}{20}$ ~~[illegible]~~ normal solution of sodium hydrate, using phenolphthalein as an indicator.

Carbonic acid (CO_2)

Sodium hydrate (NaOH)

Brazeale. Dec. 3, 1909

1. cc. normal = 100 grams soil

1. cc $\frac{1}{20}$ normal = 5 soil

This is equivalent about of 250 lbs of CaO per acre ½ foot at 2,000,000 lbs.

Copied Dec. 4, 1908.

6. ~~The~~ swamp blueberry does not thrive in soils having a neutral or alkaline reaction, but for vigorous growth it requires an acid soil.

The means commonly used to ascertain whether a soil is acid or alkaline is the litmus test. The common method of applying the test is to moisten the soil thoroughly with some kind of pure water (water containing lime will not answer), make a slit with a clean knife blade, insert a strip of neutral litmus paper (which may be secured at a drug store), press the sides of the cut together, and allow the paper to remain for a few minutes to a few hours. If the paper turns pink acidity of the soil is indicated, if blue alkalinity. The depth of the color and the quickness of the change indicating in a rough way

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the strength of the acidity or alkalinity.

In using the method just described the color change is sometimes obscured through the smudging of the paper by the soil. To avoid this one may use a neat method developed by Mr. T. R. Robinson of this Department. In the bottom of a petrie dish (a small shallow flat-bottomed circular vessel of glass) is laid a strip of neutral litmus paper. Over this is placed a disk of filter paper of the same diameter as the dish. Upon the filter paper is laid the sample of soil to be tested, and enough distilled water is poured on to moisten the soil thoroughly. The cover of the petrie dish is then pressed on, flattening the soil

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against the filter paper. The soil moisture passes through the filter paper and coming into contact with the litmus paper the usual chemical reaction takes place. By turning the petri dish bottom up the color of the litmus paper may be observed quite free from any muddying by the soil, for the filter paper does not allow the soil to come into direct contact with the litmus paper. While the petri dish is lying bottom up, a freshly wetted piece of neutral litmus may be laid down alongside the other, but on the outside of the glass. This will enable the experimenter to to make an exact observation of the degree of color change in the litmus paper within the

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dish. In delicate tests the soil should be left in the dish over night.

While one may become sufficiently expert in the use of the litmus test to form a fair judgment of the degree of alkalinity or acidity in a soil, an exact determination of this requires some different method. It was found that for the weak acids prevalent in the peat soils to the examination of which the present ~~our~~ experiments led, ~~at~~ the phenolphthalein test was the most satisfactory.

Phenolphthalein is a nearly colorless liquid, derived from coal tar. If a few drops of (over) ~~which added to an alkaline solution will turn the solution intensely pink. If the solution be acid the~~ added ~~phenolphthalein will not change it to a pink color. The application~~

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phenolphthalein be added to a solu-
tion, the solution if alkaline will
turn instantly pink; if acid
its color will not change.

The application of ~~this~~ this phenomenon to the determination of the degree of acidity of an acid solution, is as follows: A definite amount of the solution, usually 100 cubic centimeters is placed in a beaker, and into this is stirred drop by drop, by means of a special ~~[illegible]~~ apparatus, a measured amount of some alkaline solution of known strength, commonly a, as it is known to chemists, one-twentieth normal solution, of sodium hydrate. When a sufficient amount of the sodium hydrate solution has been dropped into the beaker the acidity of the acid solution becomes neutralized and it turns pink. A reading is made on the apparatus, showing the exact amount of the sodium hydrate solution used ~~required~~ ~~in effecting the~~ neutralization. ~~to neutralize the acidity of the acid solution.~~ From this reading is computed the degree of acidity ~~the acid solution~~ expressed ~~as~~

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in percentages of a normal acid solution. Now 100 cc. of a normal acid solution would require for its neutralization 100 cc. of a normal solution of sodium hydrate, or 2000 cc. of a one-twentieth, or 5%, normal solution. In a test of one of the acid nutrient solutions used in the blueberry cultures, 18 cc. of a one-twentieth normal solution was required to neutralize the acidity of 100 cc. of ~~the~~ acid solution. Since 18 cc. of a one-twentieth normal solution is the equivalent of one-twentieth that amount, or .9 cc., of a normal solution, the degree of acidity of this acid solution is .9, that is, nine-tenths of one per cent of a normal acid solution. It requires .9 of one percent of a normal alkaline solution to neutralize it.

To express ~~this~~ relation in another way, ~~nine-tenths of one cubic centimeter of a normal acid solution diluted to~~

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a solution of 100 cc. consisting of ~~to which had~~ 99.1 cc. of pure water and ~~been added~~ .9 cc. of a normal acid solution would have the same acidity as the solution thus tested.

In applying this phenolphthalein test ~~to a solid body~~ to soils the same scale is used. Thus if a soil was described ~~as giving a test of 2~~ as having an acidity of 2., it would ~~mean~~ that the acid extracted by a certain method ~~process~~ from 100 grams of the soil, dry weight, would ~~be~~ the same as that contained in 2 grams, ~~or~~ 2 cc., of a normal acid solution. The method of extraction followed for all the soil acidity tests given in this paper is ~~that described~~ as follows: (over)

~~It is one of the precautions of this method of testing acidity to boil the solution, in order to drive off the carbonic acid, before the color test is made, for the presence or absence of carbonic acid is regarded as not important in this connection. Certainly~~

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The soil ~~was~~ is first air-dried at an ordinary room temperature. Ten grams is then weighed out, shaken thoroughly with 200 cc. of hot water, and allowed to stand over night. In the morning 100 c. is filtered off and boiled to drive away any carbon dioxid present. The solution is then titrated with a 5% or $\frac{1}{20}$ normal solution of sodium hydrate, using phenolphthalein as an indicator. All the tests were made by Mr. J. T. Breazeale, of the Bureau of Chemistry, to whom the writer is greatly indebted for many courtesies and suggestions on the chemical side the experiments.

Page 9 next.

In considering the degree of acidity from the standpoint of the sense of taste it is convenient to remember that the juice of an ordinary lemon is very nearly a normal solution of citric acid (one). When the juice of a lemon is diluted to ten times its original bulk, (about) as in a large drinking glass, one has approximately a 10% normal acid solution. When diluted to 100 times, ~~making~~ about a 1% normal solution, there remains only a faint taste of acidity. The acidity of water after standing long in contact with peat in a barrel sometimes reached .5% normal. Bog water, or peat water, is sometimes ap- ~~within range of the sense of taste~~ preciably acid ~~to the taste~~.

Returning now to a considera-tion of the statement that the swamp

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No. The juice of a Mediterranean lemon averages ~~is~~ about 7% citric acid, of a California lemon about 6%. A normal solution of citric acid is 6.4%

10a

an experiment in this direction may first be cited. ~~On February 17, 1909,~~ ~~The~~ The experiment was made ~~begun~~ with twelve small glass pots, each containing a ~~small~~ blueberry seedling. The soil in the pots was a clean river sand. The plants had been in these pots for eight weeks, watered with tap water. The amount of nourishment they had received from the sand ~~soil~~ and water was very small, and when transplanted into the pots ~~the~~ all the soil of the original seed bed had been carefully ~~shaken~~ removed from the roots. Nevertheless all the plants had made extensive, even luxuriant, root growth. The tops, however, had made ~~no~~ ~~scarcely~~ no growth. There had been ~~a~~ complete stagnation or withering of the youngest leaf rudiments, and the mature ~~older~~ leaves became and remained deeply bur-

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pled.

On February 17, 1909, eight weeks after the plants had been potted in the sand, as already stated, five of the pots began to be watered with an acid nutrient solution made up, in accordance with the advice of Dr. Karl F. Kellerman, as follows:

Potassium nitrate (KNO_3)	1.0	gram
Magnesium sulphate ($MgSO_4$)	0.4	"
Calcium sulphate ($CaSO_4$)	0.5	"
? Calcium monophosphate (Ca	0.5	"
Sodium chloride ($NaCl$)	0.5	"
? Ferric chloride (Fe	trace	
Water	1000.	cc.

When first prepared this solution gave an acidity test of 1.2% normal. After standing for several weeks its acidity was still .9% normal.

Five other plants from the same twelve were watered with an alkaline nutritive solution of the following composition:

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Potassium nitrate (KNO_3) 1.0 gram
Magnesium sulphate ($MgSO_4$) 0.4 "
Calcium sulphate ($CaSO_4$) 0.5 "
Potassium diphosphate (0.5 " ?
Sodium chloride ($NaCl$) 0.5 "
Ferric chloride (Fe trace
Water 1000 cc.

By the addition of a sufficient quantity of sodium hydrate the reaction of this solution was made alkaline to the degree of .6 % normal. at the end of several weeks it was still alkaline to the extent of .48% normal.

Two of the twelve plants were left as checks, being still watered with tap water.

On March 25, 36 days after the watering ~~with the nutrient solution be gan, the two~~ began, the five plants fed with the acid nutrient solution were restored to a nearly normal green color, and

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all had begun to put out healthy new growth. The two check plants watered with tap water were still red-purple and stagnant. Of the five plants watered with the alkaline nutrient solution, three were stagnant and somewhat purplish, one was dying, and one was dead.

Plate 7, from photographs taken on April 15, 1909, shows a typical stagnant plant that had been watered with the alkaline solution, and a typical plant watered with the acid solution, which had begun to make new growth from the summit of the old stem and was pushing out a vigorous new shoot from the base. The experiment was ~~the~~ terminated ~~continued~~ not long afterward ~~the time~~, but there was every prospect that had it been continued the acid-fed plants would have made

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growth comparable with that 10a
?? shown in Plate , fig , and
?? Plate , fig .

Looking now toward the acidity or alkalinity of the other cultures thus far cited ~~described~~ [Proceed as on page 10]

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blueberry does not thrive in a
[insert pages 10a to 10z]
neutral or alkaline soil, it may
be stated that the rich garden
(6) soil described on page , which
was so remarkably deleterious to
~~blueberry seedlings was~~
alkaline. The rose cut-
tings and the alfalfa, which grew
so well in that mixture, much pre-
fer a somewhat alkaline soil.
Indeed alfalfa cannot be grown
with any degree of success in
any soil except one with an alka-
line reaction. When grown in
the humid eastern United States
alfalfa is rarely successful, ex-
cept on calcareous soils, unless
the natural acidity of the soil
has been neutralized by suita-
ble applications of lime.
The limed soil, deleterious to

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~~an experiment in this direction may first be tried.~~

blueberry plants, described on page
(8ε) gave a neutral reaction with phenolphthalein.

The heavy clay soil described
(9) on page , in which blueberry plants made very little growth, was neutral.

The thoroughly decomposed leaf
(10) mold described on page , which was shown by experiment to be markedly deleterious to the blueberry, was distinctly alkaline. A chemical analysis of this mold disclosed the reason for its alkalinity. It contained 2.86% of calcium oxid, the equivalent
? of about % of airslaked lime.

~~All but one of the deleterious soils in the experiments so far described were either neutral or alkaline. The exception was~~

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The good blueberry soils in all the experiments were acid, the acidity at times of active growth varying from 2.5% normal down to .3%

The natural distribution of the blueberries and their relatives indicates their close adherence to acid soils. They occur in abundance throughout the sandy coastal plain of the Atlantic seaboard, ~~generally~~ ~~the soil of which is generally acid, except where modified by cultivation. They occur in abundance in the cool humid~~ ~~mountain~~ ~~county~~ ~~lands of New England~~ the prevailingly acid character of which is ~~are~~ now well known through the classical experiments of Dr. H. J. Wheeler of the Rhode Island Agricultural Experiment Station. They occur generally through the cool humid hill ~~mountain~~ lands of New England, the acidity of which is notorious. They occur in sandy

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pine barrens and peat bogs throughout the eastern United States, both of which are acid. They are absent, on the contrary, from limestone soils, ~~from well drained clay soils of all kinds~~ from rich bottom lands and rich woods, where the soils are neutral or alkaline. ~~and~~ In the lower elevations of the whole subarid West, where acid soils are almost unknown, these plants do not occur. Within reach of the ~~coast~~ fogs and heavy rainfall of the Pacific coast, ~~or~~ or on the higher mountains of the interior, where conditions favor the development of acid soils, they occur again in characteristic abundance.

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7. The favorite type of acid soil for the swamp blueberry is peat.

Although the swamp blueberry sometimes grows on upland soils its typical habitat, as its name implies, is in swamps or bogs. The cranberry, it is well known, is cultivated almost exclusively in bogs. In clearing bog land preparatory to the planting of cranberries one of the necessary precautions is to remove all roots of the swamp blueberry. If the roots are allowed to remain in the ground unless pulled up they send up vigorous shoots and these develop into ~~late~~ robust plants which occupy the ground, to the great injury of the cranberries.

Large, healthy, and productive bushes of the swamp blueberry are frequent, almost characteristic, inhabitants of the uncultivated borders of cranberry bogs.

Peat bogs, in the conception of the geologist, are incipient coal

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beds. The transformation of the peat into coal occupies very long periods, perhaps some millions of years. Peat is made up chiefly of vegetable matter, the dead leaves, stems, and roots of bog plants, which are only partially decayed. Their full decay is prevented, ~~as a primary~~ primarily ~~reason~~ by the presence of water, which keeps away the oxygen of the air. ~~Under this condition~~ The bacteria, fungi, and other minute organisms by which ordinary decomposition progresses cannot live under this condition, and decay is suspended. The acids developed by this vegetable matter in the early stages of its decomposition are also destructive to some of the organisms of decay, especially bacteria. These acids act therefore as preservatives and greatly assist in preventing decomposition. So effective are these con-

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ditions of acidity and lack of oxygen, assisted in northern latitudes by low temperature, which is also inimical to the organisms of decay, that bogs sometimes preserve for thousands of years the most delicate structures of ferns and mosses.

Tests have been made of the acidity of typical peat bogs in New England, where swamp blueberries were growing. These peats were always found to be acid and the degree of acidity was within the range found satisfactory for blueberry plants in pot cultures.

The reason why peat is a particularly satisfactory type of acid soil for blueberries is, apparently, because the acidity of peat is of a mild type, yet constantly maintained.

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Not all peats are acid. About the larger, alkaline, but not destructively alkaline, springs of our southwestern desert region are deep deposits of pretty well decayed vegetable matter, that must be classed as peat. The characteristic vegetation growing on these peats, where the alkalinity is not too great, is tule (*Scirpus occidentalis* and *Scirpus olneyi*). The soil of one of the great tule swamps of the west, Lower Klamath Lake in southern Oregon, which contains thick beds of peat formed chiefly from *Scirpus occidentalis*, has been examined recently by agricultural investigators and found to be distinctly alkaline.

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The peat formed about marl ponds in the eastern United States is also, in all probability, alkaline unless formed at a sufficient distance from the lime-laden water to be beyond the reach of its acid-neutralizing influence.

Such alkaline peats, while not yet actually tried, are believed from other experiments to be quite useless for growing blueberries. Certain it is that neither blueberries nor any of their immediate relatives are found on these soils in a wild state. In the eastern United States, however, such alkaline peats are comparatively rare, and the use of the word peat conveys ordinarily the idea of acidity. All the soils used by gardeners under the name of peat are acid.

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8/ Peat suitable for the cultivation of blue-berries may be found either in bogs or on the surface of ~~the~~ ground in sandy oak or pine woods. Copied Dec. 6, 1907

In the vicinity of Washington deposits of bog peat are few and of limited extent, and the peat is thin. As a matter of fact no bog peat of local origin is used by the gardeners and florists of Washington. For growing orchids, ferns, azaleas, and other peat-loving plants, either peat shipped from New Jersey is used, or a local product sometimes known as "Maryland peat". This material is of very great interest in connection with these blueberry experiments, for it was the principal ingredient in a majority of the successful soil mixtures used, ~~Maryland peat~~ is not a bog peat at all, and since it it is desirable that the reader have a comprehensive idea of its character.

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Maryland peat, as brought to the greenhouses of the Department of Agriculture, consists of dark brown turfs or mats, two to four inches thick, made up of partially decomposed leaves interlaced with fine roots. It is found in thickets of laurel, _Kalmia latifolia_, where the leaves of this shrub usually mixed with those of various species of oaks, have lodged year after year and the accumulated layers have become partially decayed.

The nature of the deposit may be easily comprehended by means of the accompanying illustrations. The photographs from which the illustrations were made were secured through the courtesy and skill of Mr. G. N. Collins of the Department of Agriculture. The photographs were made in the month of April, 1908, in a laurel thicket at Lanham,

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Maryland. After ~~the~~ one photograph was made, the layer of leaves represented by it was removed and another photograph was taken showing the layer immediately underneath.

In Plate 8 is shown the top layer of the leaf deposit as it appeared in April, 1908, consisting of oak leaves of various species, which fell to the ground in the autumn of 1907. The next underlying layer is shown in Plat 9. The laurel leaves are those that fell in the summer of 1907. Laurel being an evergreen its leaves are not shed in the autumn like those of the oaks. They remain on the bush until the new leaves of the following spring are fully developed and then the old leaves begin to fall. It is this circumstance of the fall of the oak and laurel leaves at different periods of the year which enables one to recognize the (over)

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different layers ——— and know their exact age.

The third layer, shown in Plate 10,
consists of oak leaves ~~of~~ the autumn of 1906.
This layer was moist and decompo-
sition was well started. The presence of fun-
gus growth is evident to the eye, as is
also the experiment of various small
animals. ~~The part played by~~ The larvae
of insects and ~~the~~ thousand-legged
worms in hastening the decomposition
play a very important part,
of leaves. must under some conditions,
The fourth layer, Plate 11, consisting of
laurel leaves shed in the summer
of 1906, is in about the same con-
dition as the preceding. In the fifth
illustration, Plate 12, ~~showing~~ the leaves of 1905
but with the ~~line of demarcation be-~~
~~tween laurel and oak not read-~~
ily layer of oak leaves not readily
separable from the laurel, the
leaves crumble readily and de-
composition has so far progressed
that a few oak rootlets are found spread
out between the flattened leaves.

Plate 13 shows the rotted leaf layers of 5
1904 interlaced with the rootlets of
laurel and oak. It is this root-
bearing layer, two inches or more
in thickness, of which Maryland
peat is composed. The lower por-
tions of it ~~have~~ reached a some-
what greater degree of decompo-
sition than is here shown.

~~One who has observed the rot-~~
~~ting of leaves~~ In a rich woods
of the trillium-producing type,
such as a fertile sugar maple forest, ~~in~~
~~fertile soil,~~ one may observe that
the leaves in rotting seldom ~~stay~~
~~retain their form~~ longer than
~~on the ground~~
two years and that the line of
demarkation between the thin leaf
litter of the forest and the under-
lying woods mould is sharp and
clear. ¶ In ~~this case~~ the sugar maple woods, the decomposition
~~of the decomposition~~ of the leaves is

rapid. In the Maryland, or Kalmia, 6 peat, as it may be called with more exactness, the decomposition is slow. The cause of this difference in the rate of decomposition is the ~~difference of~~ acidity in the two cases, and this in turn is dependent on the nature of the leaves and ~~the nature~~ of the underlying soil, particularly whether the soil is acid or alkaline. A slight alkalinity in a soil greatly favors the decomposition of the leaves overlying it (on).

~~The writer regards~~ These upland leaf deposits, in which decomposition is retarded for many years, ~~by acidity through the killing of the micro-organisms of decay by the acids~~ ~~present~~, the writer regards as essentially peats, and to distinguish them from bog peats he would call them upland peats. An upland peat may be described as

an acidity as strong as that shown to occur in newly fallen oak leaves (see page) cannot help having a pronounced effect in maintaining the acidity of the lower leaf layers, for it must be remembered that these acids are soluble in rainwater and are therefore continually leaching down from the upper through the lower layers of rotting leaves.

7. For vigorous growth the swamp blueberry requires an acid soil.

a nonpaludose deposit of organic 7
matter, chiefly leaves, in a condition of suspended and imperfect decomposition and still showing its original leaf structure, the suspension of decomposition being due to the development and maintainence of an acid condition which is inimical to the growth of the microorganisms of decay.

(over) ~~The~~ Kalmia peat should be piled up and rotted for several months before blueberries are transplanted into it. An experience of the writer which emphasizes the need of this

(20?) treatment is given on page . If stacked as soon as it is dug it ~~will~~ usually retains sufficient moisture to carry the rotting forward ~~when~~ even if the stack is ~~not ...~~ under cover.

Kalmia peat has proved to be

6. The swamp blueberry does not thrive in soils having an alkaline reaction.

The use of the name "leaf mold", sometimes applied to this upland peat, should be restricted, it seems to the writer, to the advanced stages in the decomposition of leaves, in which leaf structure has disappeared.

a highly successful soil for growing blueberries. It has been tried both pure and in many mixtures, as will be described in the paragraphs beginning on 20) page.

An upland peat formed of the leaves of scrub pine (*Pinus virginiana*) has also been tried for blueberry seedlings. They grow well in it.

Oak leaves it is believed, rotted for ~~about~~ one or two years would make a good blueberry soil. In the Arlington National Cemetery is a ravine in which large quantities leaves, chiefly oak, have been dumped for many years. Samples taken there in late November, 1909, ~~and tested for acidity~~ show an acidity, in the case of freshly fallen leaves, of 40% normal; in leaves apparently one year old. 6%; ~~in leaves about two years old. 2%.~~

and in leaves about two years old .2%.

A condition of great interest was found in one of these piles of leaf mold ~~in this same~~ ~~portion~~ ~~in~~ which was several ~~three~~ years old. ~~...~~ It was mellow and black, and the evidences of leaf structure had disappeared. When submitted to the phenolphthalein test it proved to be alkaline, and upon chemical examination it was found to contain 3.55% of lime (CaO). In this case decomposition had progressed so far, and the acidity had dropped so low, that the lime in the leaves, remaining constant in amount, ~~...~~ had neutralized the remaining acidity. ~~and~~ the material ~~...~~ then becoming alkaline had proceeded to decompose with greater rapidity, until a real mold had been formed.

10

The condition here observed is doubtless the same as that which occurs in the drained bog, or so-called "muck", lands of Michigan. When first ploughed they will grow only certain acid-resistant crops, such as

3 but later as their acidity disappears they come to attain ~~the~~ a very high~~est~~ degree ~~type~~ of fertility. It is probably a phenomenon of similar character which is taking place in the drained swamp lands of the lower Sacramento River in California, where the ~~alkalinity of the~~ soil, which is already in a state of remarkable fertility, is becoming increasingly alkaline.

~~The writer may here~~ ~~[illegible] the [illegible] may be permitted here,~~ Here the writer may allude to another phenomenon, that of the occurrence of the swamp blueberry and certain plants, such as

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the purple lady's slipper (Cypripe- 11.
dium acaule) and the swamp
honeysuckle (Azalea nudiflora),
in two kinds of situation, one a
peat bog, the other a sandy,
well drained, and often dry upland.
The favorite explanation of this phenom-
enon among botanists is that these
plants are naturally adapted to the
dry situation and that in the bog
they find a situation of "physiolog-
ical dryness", or vice versa.
~~Certainly the writer's experiments show~~
~~that~~ This ~~explanation~~ ~~will not~~
~~answer for the blueberry.~~ Its oc-
currence in these two habitats
is dependent on the acidity of
both situations. No amount of
~~dryness~~ ~~acidity~~ will make a blueberry
~~grow~~ flourish in any upland soil if
that soil is not acid.
The writer's [illegible] have
shown that

No.

While the writer does not question the physiological dryness of a peat bog the explanation that a bog plant finds an upland situation congenial because it is dry certainly will not answer for the blueberry.

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9/ Dec [illegible] 1931

Cutting [illegible] Fruiting cuttings [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] found [illegible].

Cuttings [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

Cuttings [illegible]. Five [illegible] [illegible] cuttings [illegible] new shoots just coming [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

Samples of soils for [illegible] tests ~~[illegible]~~ taken by [illegible]

[illegible] [illegible] from the pile [illegible] about [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] ago.

'Next. Dec. 7, 1909

Culture 239. Half a flat. Soil ~~sifted~~ put in flat to-day, pure kalmia peat coarsely sifted.

Culture 240. Half a flat. Soil put in flat to-day Kalmia peat coarsely sifted 9 parts, manure 1 part.

Budded plants in greenhouse. The inserted bud has started in none, though four have [illegible] trying to [illegible], [illegible] buds belonging to the stock. These four are [illegible] 185, 17, and 70. [illegible] 182 is [illegible]. Two, 21 and [illegible] are alive but [illegible]

[illegible]

Vaccinium corymbosum. All the plants have [illegible] their 3-[illegible] [illegible] plunged, but [illegible] [illegible] seem. The house they are in is too shaded and too moist, perhaps too warm. Some of the taller have fallen down and are sending new shoots from the base. A mildew has appeared on some.

Dec. 7, 1909

Kinsler. From Columbia to Camden, in the long leaf pine country, fine huckleberries are found along the branches. Best one about 3 feet high. Fruit in June. Big bunches. Blue berry. Very productive.

Columbia an excellent place to

Dec. 8, 1909.

Experiment. Set out in a deep glass vessel, and against the side of the glass, in ~~peat~~ (perhaps pure) sand watered with peat water or sand & loam with peat an old blueberry plant, the lower part of the aquarium containing standing water rising half way up the old root ball of the plant. Hold the water at this level till ~~the~~ root growth ~~has be~~ is well under way, and then let the water level gradually settle. The object of the experiment is to ascertain whether new root growth will form beneath the water surface, and whether roots that have remained long beneath the water surface will so retain their vitality that when they emerge they will ~~still~~ put forth vigorous root growth.

A.14 Copied Dec. 8, 1908.

9. For active growth the swamp blueberry requires a well aerated soil. Consequently, the swamp blueberry does not continue in active growth in a soil saturated with water.

In its natural distribution the swamp blueberry does not grow in the lower, wetter type of bog. In a typical leatherleaf (<u>Cassandra calyculata</u>) bog, for example, the swamp blueberry is found either about the margin of the bog or on hummocks. In both these situations ~~cases~~ most of the roots of the blueberry bushes stand above the summer level of the water in the bog. When ~~the general surface of~~ a bog has been built up by the growth of ~~its~~ vegetation and the accumulation of its débris, until ~~its~~ the surface is ~~sufficiently~~ ~~i~~ above ~~the~~ the summer water level, the swamp blueberry will occur generally over ~~its~~ ~~surface~~ the bog.

An examination ~~of the roots~~ of blueberry plants occurring on hummocks and bog margins has shown that such roots as extend beneath ~~below~~ the permanent summer water level bear few feeding rootlets or none at all.

In one experiment ~~which~~ it was attempted to grow blueberry seedlings in ~~==~~ water cultures containing various dissolved nutrients. ~~in solutions~~ It was found that ~~the~~ ~~when submerged~~ the roots made no new growth, ~~and~~ that the new leaves were few and small, and that the general health of the plants was not good, whatever the character of the nutrient substances in the solutions. It was frequently observed also in the various soil cultures, particularly those in undrained glass pots, that

the continued saturation of the soil with water reduced the root growth and enfeebled the whole plant. Continued excessive watering of potted blueberry plants was found always ~~generally~~ injurious.

The observations just recorded must not be misunderstood to mean that submergence of the roots is always injurious to the swamp blueberry. In winter and early spring the water level of bogs containing blueberries ~~is~~ often [illegible] high enough for several months to completely submerge the whole root system of the plants. On the

Sht. 1 lower end of the cranberry bog near Wareham, Mass., are some native bushes of the swamp blueberry ~~bushes~~ the roots of which have been submerged in three feet of water

~~9~~. Peat suitable for the swamp blueberry may be found either in peat bogs, or on the surface of the ground in sandy oak or pine woods.

from December to May each year for about twenty years. These bushes when observed in September, 1909, gave every evidence of vigor. Their twig growth was of good length and thickness, their foliage was dense and of a healthy color, their flowering buds for the next year were fairly numerous, and the bushes were said to be as productive of fruit as neighboring bushes on higher ground.

It would appear from these facts that, while submergence during the dormant period is not injurious to the swamp blueberry, its roots during the active growing period must be above the water level and well aerated.

8. The favorite type of acid soil for the swamp blueberry is peat.

Slip, p. 11. Copied Dec. 9, 07

Addition to statement 6

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The consideration of this statement requires first an understanding of the means used to determine whether a soil is acid or alkaline.

The simplest means

Slip, p. 11a

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A drinking glass with a flat bottom makes a fair substitute for the Petri dish.

slip 11 b

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A soil would have an acidity of 100% when an extract of 100 grams of the soil, dry weight, made by a certain method in 100 cc. of water would give a normal acid solution. If a soil were described as having an acidity of 2, or 2% normal, it would mean that the extract of 100 grams of it in 100 cc. of water would be a 2% normal acid solution, that is, that 100 cc of the solution would contain 2 cc. of a normal acid solution.

Slide 11c

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The expression "normal solution" used in this paper, it must be understood, is the normal solution of chemists, not of surgeons. ~~[illegible]~~ Surgeons use the expression "normal salt solution" to describe a certain weak solution of common salt in water, which has ~~having~~ the same strength as the ordinary solution of salt in the blood. A normal solution ~~of chemists~~ in chemistry is a solution of certain fixed strength based on the molecular weight of the substance under consideration. Normal solutions of the various acids have the same ~~strength~~ degree of acidity. Normal solutions of ~~alkalies~~ alkaline substances are equal to each other in alkalinity. A measured amount of a normal solution of an acid (over)

will exactly neutralize an equal amount of a normal solution of an alkaline substance.

Dec. 9, 1909.

Experiment. Mr. Collins suggests that in order to establish lack of aeration as the cause of the failure of a blueberry plant to grow in an acid nutrient solution, one of these liquid mixtures should be connected with a laboratory air blast in such a way that a continuous trickle of air will pass through the solution.

This should be tried.

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Temperature in forcing frame went down last night to 21° ~~22~~. At half past eleven A.M. it was still below freezing. The sphagnum tops were frozen as was the top of the soil in the sphagnum pot, which was next the glass. Out doors ~~both~~ the soil on the surface of the pots was frozen as well as the remaining sand.

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Dec. [illegible], 1907.

Refrigerating [illegible] went down to 23° last night [illegible] [illegible] in all pots [illegible], and slight [illegible] formation [illegible] on the surface of the tube.

Culture [illegible]. Eighteen [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], [illegible].

Culture [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] a [illegible] [illegible] [illegible] [illegible].

Culture 224. [illegible] [illegible] [illegible] examined [illegible], [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] about ½ inch [illegible].

Culture 223. Three root cuttings examined, all callused [illegible] [illegible] end, one with a [illegible] [illegible] callus at the [illegible] end. These [illegible]. [illegible] [illegible] [illegible].

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p. 15 Copied Dec. 10, 1937.

10. Aeration conditions satisfactory for blueberries are prevalent in sandy soils.

14 In the experiment described on page it was found that blueberry seedlings having their roots suspended in nutrient solutions even though the solutions were suitably acidulated failed to make a normal growth. This failure was ascribed to lack of aeration. In another experiment described on

11c 11e pages to it was shown that a similar nutrient solution when used to water a blueberry plant potted in sand produced a normal growth of both roots and stems. The sand furnished no appreciable nourishment and the only essential difference in the two cases was the abundant root aeration afforded by the sand culture.

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Sand is therefore regarded as having been shown experimentally to be a suitable aerating medium.

In their wild state blueberries are especially prevalent on the sandy soils of the Atlantic coastal plain as well as on sandy plains and pine barrens in the interior. The drainage of such soils is good and their aeration is excellent.

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p. 15

Copied Dec. 1, [illegible]

In all the experiments in which blueberry seedlings were grown in sand cultures suitably acidulated the root growth was poor even though very little nourishment was given the plant, and when fed with a weakly acid nutrient solution or with peat water the sand-potted plants always made a luxuriant root growth.

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Dec. 13, 1909

Culture 30. These plants taken from window sill and plunged in sand out doors.

Culture 145. Taken from window sill and placed out doors, cold frame.

Chigaea. Pot from propagating frame, frozen,

placed in greenhouse no. 1.

Culture 113. Glass pot plunged in sand in large pot and put back on window sill.

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p. 16. Copied Dec. 14, 1904

11. Aeration conditions satisfactory for the growth of ... are found in drained fibrous peat.

Kalmia peat when in the original turfs or mats is full of small roots, rootlets, ... and other plants. In this condition it is remarkably porous and well aerated. ~~S~~ Pieces of these turfs were used with great success in the bottom of pots, in place of crocks, to afford drainage. For a potting soil, however, kalmia peat cannot easily be used until the soil has been shaken from the mass of roots or has been rubbed through a screen. Even in that condition the presence of fragments of leaves and rootlets makes the whole mass porous.

A pot containing pure kalmia peat prepared by ~~such rubbing~~ ... remains moist yet well aerated.

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for days at a time without watering. ~~This~~ moisture condition is due to ~~two~~ remarkable properties of peat, its high capacity for holding moisture and the tenacity with which it clings to it. # Kalmia peat taken from the interior of a stack after it has remained several months under cover ordinarily contains 100% of water, computed on the dry weight of the peat. Even with this very high water content a peat soil is in a beautiful condition of tilth, mellow, well aerated, and to the sight and touch ~~that~~ only moderately moist. Ordinary loam in a similar condition contains only about ~~20~~ 18 per cent of water, and sand about ~~20~~ 3 per cent. When saturated with water the moisture content of ~~kalmia~~ peat is about

The ability of peat to retain its

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moisture depends in part on the gradual drying of the superficial layers and the consequent formation of a mulch, but more particularly is it dependent on a certain natural physical ~~property~~ affinity that peat possesses for water. (over) ~~a high degree, to more~~ ~~This may be described as the ability to withstand drying~~. A test of kalmia peat made by Mr. Lyman J. Briggs of the Department of Agriculture, the originator of this method of measurements, showed a moisture equivalent of 142% as compared with about 30% for clay ~~...~~, 18% for loam, and 2 to 4% for sand.

From what has been said it is evident that fibrous kalmia peat has a texture that admits of ample aeration while at the same time holding abundant

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The comparative strength of this water-holding power in different soils may be tested by subjecting them ~~soils~~ to a powerful centrifugal force, ~~to~~ ~~standard being~~ which tends to throw the moisture out of the soil. The standard centrifugal force used ~~we~~ is ~~1000~~ a thousand times the force of gravity. The percentage of moisture remaining in the soil after this treatment is known as the moisture equivalent of that soil.

moisture for the supporting of 4
plant growth.

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Dec. 17, 1907

Culture 221. Dendrobium seeds sown up to-day, about half a square of [illegible]

Culture 241. Half a flat. Soil put in flat yesterday, kalmia peat 9, sand 1.

Culture 242. Half a flat. Soil put in flat yesterday, kalmia peat 8, sand 1, [illegible] 1.

Culture 243. Half a flat. Soil put in flat to-day. kalmia peat 8, loam 1, sand 1.

Culture 244. Half a flat. Soil put in flat to-day, kalmia peat 7, loam 1, sand 1, [illegible] 1.

Culture 209. Taken from 40 to [illegible] house [illegible] about 65° at night.

[illegible] with [illegible] the [illegible] This [illegible] contains 5 plants about [illegible]

[illegible]

239 Twenty-eight plants from Culture 195 Nov. 6
~~trans~~planted into the field today by
[illegible]. Seed [illegible] not removed,
~~[illegible]~~
[illegible]
[illegible]
[illegible].

Culture 240 [Same]

Culture 241 [Same]

242 [Same]

243 [Same]

244 [Same]

Dec. 16, 1906

Culture 164. Brought from cold house (40° at night) to house no. 1 to-day ~~[illegible]~~ 65° at night ~~[illegible] at night~~

Culture 201, ~~[illegible]~~ [Same]

" 210 "

" 211 "

Culture [illegible]. All the remaining cuttings taken from the bed and [illegible] examined. All were [illegible] or completely dead, most of [illegible] the [illegible] (dead) being [illegible] [illegible].

Only one had [illegible] roots, and that one [illegible] [illegible] [illegible], including the [illegible].

Culture 222 All these root cuttings taken up for examination. All alive and callused at one or both ends. None rooted. One with a [illegible] [illegible], replaced.

Culture 223, All the cuttings taken up for examination. All alive and callused. none rooted. All replaced.

Culture [illegible]. [illegible] [illegible] [illegible] specimens [illegible] cuttings taken up for examination. [illegible] [illegible] [illegible] none at [illegible]. [illegible] callused [illegible] no roots.

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12/ Aeration conditions satisfac-
tory for the swamp blueberry are
found in masses of live, moist,
but not submerged sphagnum.

~~When growing~~ In some swamps in ~~which~~
the water level remains perma-
nently above the general surface of
the ground. When growing in such situations the swamp blueberry
~~stands~~ upon hummocks the sum-
mits of which rise above the water
during the growing season.
Unless the water level is extremely
variable or the ground is densely shaded, these hummocks are
usually covered ~~clothed~~ with a cushion of
live sphagnum moss. It is a pe-
culiarity of this ~~sort~~ of moss that
it absorbs water with great avid-
ity. If one ~~end of a~~ partially dried branch of
sphagnum ~~be~~ is brought into con-
tact with a little ~~[illegible]~~ water, the
whole branch becomes wet almost

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Sphagnum reaches its highest development in cedar swamps

instantaneously. The water rushes along with marvelous rapidity ~~both~~ through the cells of the plant and especially through the interstices between the overlapping leaves. The white air spaces between the half dry leaves flash out of existence one after the other like candle flames in a gust of wind.

Sphagnum is one of the most absorbent substances known. If the lower part of a cushion of sphagnum is in contact with free water the ~~a sufficient amount of the~~ fluid is conveyed from stem to branch and from plant to plant in ~~suf-~~ sufficient amount to render the whole mass as wet as a sponge.

When one squeezes a handful of such moss ~~from~~ taken a foot or more above the source of moisture a stream of water

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runs out. ~~may be ignored~~. The cushion of sphagnum tends to build itself up, by the gradual process of growth and decay, to the maximum height to which ~~the moss~~ it can convey the large amount of water required for ~~the~~ its growth, ~~of the sphagnum~~.

The ~~innumerable~~ air spaces between the sphagnum plants and among their branches furnish ample aeration. ~~The~~

~~[illegible]~~ If the sphagnum cushion on a blueberry hummock is examined ~~find~~ the whole mass will be found interlaced with the [illegible] completely of the blueberry to the level of the underlying soil. ~~far above the [illegible] to complete~~ The combination of per- [illegible] ~~[illegible]~~ moisture and [illegible] found in these thorough aeration sphagnum cushions seem to be almost ideal for the development of blueberry roots.

It must not be assumed that the vigorous growth of blueberry roots in sphagnum is due to any high

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nutritive quality of the sphagnum itself. Such a conclusion would be erroneous. As shown by chemical analysis sphagnum ~~is~~ contains little ~~very low in~~ plant food. ~~substance.~~

When set out in ~~pure~~ sphagnum and watered with tap water blueberry plants remain healthy but they do not grow as luxuriantly as when set out in peat. From experiments with the growing of blueberries in ~~[illegible]~~ sand watered with peat water it is known that such water ~~is in itself able to~~ furnishes the food materials necessary for vigorous growth. It is reasonable to conclude therefore that the chief nourishment of a blueberry plant growing on a pure sphagnum hummock comes from the bog water sucked up by the sphagnum, and not from the sphagnum

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itself.

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Culture 239. Height of plants as follows:

A1	15 mm.	B1	10 mm	C1	12 mm.
A2	25	B2	15	C2	15
A3	25	B3	13	C3	15
A4	15	B4	10	C4	13

D1	15 mm.	E1	10 mm.	F1	15 mm.	G1	13 mm
D2	15	E2	25	F2	17	G2	18
D3	20	E3	17	F3	15	G3	17
D4	17	E4	12	F4	10	G4	10

Culture 240 Height of plants as follows:

A1	13 mm	B1	17 mm.	C1	15 mm.	D1	15 mm.
A2	22	B2	16	C2	20	D2	18
A3	20	B3	25	C3	17	D3	15
A4	15	B4	15	C4	15	D4	13

E1	15 mm.	F1	26 mm.	G1	7 mm.
E2	26	F2	22	G2	15
E3	20	F3	22	G3	18
E4	8	F4	13	G4	13

Culture 241 Height of plants as follows:

A1	10 mm.	B1	10 mm	C1	10 mm.	D1	13 mm.
A2	18	B2	17	C2	15	D2	14
A3	17	B3	20	C3	11	D3	15
A4	13	B4	8	C4	8	D4	13

E1	15 mm.	F1	8 mm.	G1	12 mm.
E2	16	F2	13	G2	13
E3	14	F3	10	G3	17
E4	10	F4	12	G4	13

Dec. 15, 1909

Culture 242, Height of plants as follows:

A_1 20 mm.	B_1 18 mm.	C_1 13 mm.	D_1 17 mm.
A_2 18	B_2 28	C_2 15	D_2 23
A_3 22	B_3 18	C_3 27	D_3 17
A_4 17	B_4 13	C_4 15	D_4 10

E_1 15 mm.	F_1 15 mm.	G_1 13 mm.
E_2 24	F_2 17	G_2 17
E_3 20	F_3 15	G_3 17
E_4 12	F_4 18	G_4 12

Culture 243, Height of plants as follows:

A_1 20 mm.	B_1 10 mm.	C_1 15 mm.	D_1 10 mm.
A_2 20	B_2 10	C_2 10	D_2 14
A_3 18	B_3 10	C_3 10	D_3 13
A_4 15	B_4 12	C_4 10	D_4 8

E_1 13 mm.	F_1 15 mm.	G_1 17 mm.
E_2 20	F_2 15	G_2 20
E_3 25	F_3 13	G_3 18
E_4 13	F_4 12	G_4 13

Culture 244. Height of plants as follows:

A_1 15 mm.	B_1 13 mm.	C_1 [illegible] mm.	D_1 12 mm
A_2 22	B_2 12	C_2 15	D_2 18
A_3 11	B_3 15	C_3 17	D_3 10
A_4 13	B_4 15	C_4 18	D_4 10

E_1 15 mm.	F_1 15 mm.	G_1 10 mm.
E_2 25	F_2 17	G_2 18
E_3 13	F_3 17	G_3 25
E_4 12	F_4 12	G_4 12

BPI

Dec 15, 1909.

Culture 195. Sprinkled with fine sand yes-
today. Sand green on top to-day in places.
Culture 159. Half sprinkled with fine sand
yesterday, not green on top to-day. The
half sanded contains 9 plants, the other
half 5.

Nov. 2[illegible], 1909.

[illegible] Many seeds [illegible] germinating [illegible] 22°. Corn moved from the [illegible] [illegible] frame, where it [illegible] [illegible] [illegible] to the cold house; [illegible] [illegible] [illegible] [illegible] in front of the [illegible] [illegible] [illegible]

[illegible] 3, 33. [illegible] plants in the cold house [illegible] [illegible] growth, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the growth, [illegible] [illegible] [illegible]

[illegible] the [illegible] [illegible] [illegible] [illegible] or [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]. The [illegible] [illegible] [illegible] [illegible] in the cold [illegible] [illegible] [illegible] in [illegible] [illegible].

Dec. [illegible], 1939.

Cutting 229. Fourteen root cuttings taken [illegible] as 229 A a week ago.

Cutting 229 A. Fourteen root [illegible] cuttings taken [illegible] a week ago and set in the [illegible] cutting bed in the [illegible] house in yellow sand. About [illegible] had a small callus and about [illegible] had new rootlets, according to [illegible] Mr. [illegible].

[illegible] [illegible] The [illegible] ~~[illegible]~~ cuttings [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], 01 [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] show above [illegible] sand.

Cutting 155. Cutting [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

[illegible] 192 + 192 A. Plants [illegible] [illegible].

Cutting 157. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

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13. The swamp blueberry is devoid of root hairs, the minute organs through which the ordinary plants of agriculture absorb their moisture and food.

The structure of the root hairs of ordinary agricultural plants may be understood by reference to Plate 14, which illustrates these organs as they occur in a wheat plant grown in a nutritive solution. Attention is directed particularly to the root hairs. It will be observed that the wall of the root hair is very much thinner than the wall of the cell from which ~~the root hair~~ it springs, and furthermore that the surface area of the root hair is many times greater than that of the cell itself. The chief function of these root hairs is to absorb for the use of the plant the soil moisture and the plant food materials dissolved in it. In connection

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when the root hairs are enabled to perform with great efficiency because of the two characteristics just mentioned, their large surface area and the thinness of their walls.

The rootlets of the blueberry are remarkable in having no root hairs whatever, as may be seen by reference to Plate 15. ~~The rootlets are very slender, ranging from 12 to 20 [illegible] in diameter. ten [illegible] for the [illegible] thinness [illegible] rootlets [illegible] [illegible] epidermal cells are visible~~

The walls of the superficial, or epidermal, cells of the rootlets are thick, measuring

? ? as compared with for the walls of the root hairs of wheat. Notwithstanding the fact that the blueberry's roots are fine and numerous their actual absorptive capacity would appear to be small, in consequence of the absence of root hairs.

(over)

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~~a blueberry which growing~~ / ~~can~~

It is found by a computation that a section of a bearing rootlet (having no root hairs) presents

? about one the surface of an equal length of a wheat rootlet bearing root hairs, and the ~~thickness of the~~ suberized membrane

? in the wheat ~~averages~~ only about ~~times~~ that in the blueberry. Further the blueberry rootlet

? grows only about mm. a day under favorable conditions, while the wheat

? rootlet grows about times as fast. In all the provisions for rapid food absorption in the one ~~case~~ plant and retarded absorption in the ~~blue-~~ other ~~berry~~ we find a reason for the contrastingly very slow rate of stem growth that characterizes the blueberry plant. The importance of slow root absorption ~~in the roots of these plants~~ and the danger to which these plants would be subjected if their roots absorbed water rapidly is discussed

(24) on page

The young rootlets of the blueberry, before they branch, are exceedingly slender, varying from .0012 to .0020 inch in diameter. This makes them very susceptible to actual drying and they are easily "killed" by it. This characteristic has an important bearing on the treatment of these plants when in pots. The matter is dis-
25 cussed on page

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14. The rootlets of healthy plants of the
swamp blueberry are inhabited by a
fungus, of the sort known techni-
cally as an endotrophic myco-
rhiza.

As already stated the ultimate rootlets
of the blueberry are very fine, their diam-
eter varying from .0012 to .0020 of an inch
in diameter. In rootlets of the smaller
size about three rows of epidermal
cells are visible in a lateral
view, in the larger rootlets about five
rows. In a newly grown rootlet not con-
taminated with soil particles these
epidermal cells, and indeed all the
underlying cells as well, are as trans-
parent as glass, and were it not
for the difficulties due to the refrac-
tion of light the examination of the con-
tents of these cells would not be diffi-
cult. As a matter of fact the study
of the contents of the live cells is diffi-

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cut, their intelligent examination requiring
the use of an oil immersion objective
and microscopic enlargements of [illegible] to
diameters. The darkened window
installation for a microscope, devised
by Dr. N. A. Cobb and used in his
laboratory, has been found almost
indispensable in this work. The writer
is greatly indebted to Dr. Cobb for the
use of these facilities.

Clean rootlets may be procured
readily from ~~growing~~ active blueberry plants
in the open spaces between the rocks
[illegible], or in [illegible], or in the
sphagnum, or at the outer surface of the ball
of soil in earthen pots. Rootlets [illegible]
from live sphagnum are especially
clean.

They are conveniently stained [illegible] [illegible] [illegible] in water.

Ordinarily the only thing visible
in one of the live epidermal cells is the minute
cell nucleus as shown in plate 15, fig. [illegible], lying close to the cell wall.
The protoplasmic membrane
lining the cell is very thin and is in-
visible except where it is thickened to

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envelop the nucleus. The remainder of 3
the cell is filled with the colorless cell sap. An examination with medium enlargements will show some of the cells faintly clouded in appearance. A higher power, such as is afforded by
? a oil immersion objective and
? an eyepiece, with proper illumination will resolve the cloudiness into a mass of fungus threads or hyphae. ~~threads~~ These may be few, making only two or three irregular turns about the interior of the cell, as shown in plate 16, figure a, or they may be more numerous, even occupying the whole sap space, as shown in figure b of the same plate, in a dense knot of interwoven and irregular snakelike coils. These hyphae are about one ten-thousandth
? of an inch (2 to 4 μ) in diameter.

On the outer surface of the cells containing these fungus threads others of similar thickness may be observed. Sometimes they are trans-

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parent and their detection requires the same high power of the microscope as do those in the interior of the cells. Sometimes, however, these exterior threads having pale brown color and are then readily seen. Their surface is smooth, devoid of markings of any kind. Ordinarily the ~~~~ thread wanders loosely along the surface of the root giving off an occasional branch and having an occasional septum. Sometimes the threads and their branches may form an open network about the rootlet, as shown in plate 16, figure , but they never form a dense sheath of hyphae such as is characteristic of the mycorhiza of the oak.

The connection between the external and the internal hyphae is not easy to see at a single observation, for the ~~passage of which~~ the hypha ~~passes from cell to~~ through the cell wall is rarely

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caught in optical section, and even then a clear observation is usually rendered difficult because of refraction. A very clear case, however, was observed in a rootlet of laurel, *Kalmia latifolia*, a shrub which has a mycorhizal fungus similar to that of the blueberry. A drawing of that specimen is shown in plate , figure

The passage of the fungus through the cell wall may frequently be observed by first focusing on the external hypha at a point where it appears to have a lateral branch or a very short branch, and then focusing slowly downward. In this way one passes from the external to the internal part of the fungus, having had some portion of the intervening hypha continuously in view. The hypha always

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appears much constricted at the point where it goes through the cell wall.

This fungus is of the type named
? by Frank in 18 as an endotrophic mycorhyza, to distinguish it from an ectotrophic mycorhyza such as occurs on the roots of oaks. In the latter type of mycorhyza the hyphae of the fungus form a dense sheath around the rootlet, completely shutting it off from direct contact with the surrounding soil. The loose hyphae on the outside of the sheath resemble root hairs and it is supposed to be a part of their function to absorb soil moisture and transmit it to the oak rootlet just as root hairs do.

It has not yet been possible, for

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want of time, to study the life history
of this mycorhizal fungus of the blueberry. There
is however a clue to its identity
in the work of Charlotte Ternetz
(24) described on page

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March 7, 1934.

[illegible] [illegible] I [illegible] the [illegible] [illegible] [illegible] when the [illegible] was [illegible] into ~~[illegible]~~ ~~[illegible]~~ [illegible] have [illegible], the [illegible] [illegible] [illegible] and the [illegible] [illegible] [illegible] it. The [illegible], however, [illegible] [illegible] and new leaves are [illegible] [illegible] the [illegible] ones

[illegible]. Good growth has [illegible] [illegible] [illegible] [illegible] not [illegible] [illegible] [illegible]. [illegible] young leaves [illegible] [illegible] [illegible] [illegible] plant, the one that [illegible] [illegible] [illegible] [illegible] some time [illegible] [illegible] [illegible] [illegible] house [illegible].

~~[illegible] [illegible] [illegible] [illegible] [illegible]~~
~~[illegible] [illegible] [illegible]~~

[illegible] [illegible] [illegible] [illegible] hots of our [illegible] plans is [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

The [illegible] [illegible] frame, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] covered with [illegible] [illegible]

[illegible]

~~[illegible]~~ [illegible]

[illegible]

[illegible]

[illegible]

Culture 230 Height of plants to-day.

	Label	
1		2
2.8 cm.		3.5 cm.
3	4	5
4 cm.	4.5 cm.	3 cm.
6	7	
4.3 cm.	2.2 cm.	

Plant no 3 ~~The 4 cm. plant~~ has two basal [illegible] from the [illegible], 5 and 10 mm. long, eleven foliage leaves. Only none of the plants is [illegible].

$\frac{( ) 2 [illegible] 3}{4.}$

Culture 231. Height of plants to-day.

Label

4.5 cm. 3 cm

3.7 cm. 3.7 cm. 4 cm.

2.5 cm 3 cm

None of the tips is [illegible], and none of the plants has a basal [illegible].

$6)\frac{24.4}{4.}$

Culture 198 Height of plants to-day

Label

1.5 cm (badly injured) 3.5 cm.

2.8 cm.

3.5 cm. 1 cm (badly injured)

$3)\frac{9.8}{3.3}$

1.22

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15. The mycorhizal fungus of the swamp blueberry appears to have a beneficial effect upon the blueberry plant.

The epidermal cells in which the mycorhizal fungus occurs to differ in no respect from other epidermal cells of the blueberry root. ~~They~~ are not swollen nor distorted, nor do their contents collapse. They appear In rapidly growing rootlets the ~~mycorhizal~~ fungus seems not to be able to keep pace with the rootlet itself and the fungus may not occur for a considerable distance back from the growing tip. The fungus-filled cells ordinarily are most numerous on the small short lateral rootlets the growth of which is soon of a vigorous plant When root growth is retarded or becomes even stagnated the fungus may invade the epidermal cells to the very tip. Sometimes half the cells in such a rootlet

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are gorged with fungi, yet the delicate cell walls show no displacement or distortion ~~[illegible]~~. There is no indication whatever that the ~~[illegible]~~ fungus causes any pathological disturbance or is in any way obnoxious to the plant. On the contrary the uniformity with which it has been found to occur on healthy plants and its frequent absence or scarcity on sickly plants are facts suggestive of a beneficial influence.

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17 The deficiency of available nitrogen in the acid peaty soil in which the swamp blueberry grows best is due to the inability of the nitrifying bacteria to thrive in such a soil, because of its acidity.

In order to understand the conditions antagonistic to nitrification which exist in good blueberry soils it is necessary first to discuss the source and transformation of nitrogen in ordinary soils.

The available nitrogen in the soil, such as is absorbed by an ordinary plant, is usually derived, unless fertilizers have been applied, from the decomposition of the humus contained in the soil, and the humus is itself a product of the decomposition of plant and animal remains. These remains (over)

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~~[illegible] matters~~ consist ordinarily and chiefly of the partially rotted leaves, stems, and roots of plants.

In the older agricultural literature the name humus was applied to a particular kind of soil, which is

more properly covered by the terms vegetable mold, leaf mold, and
(10) woods mold. (See page) Later
the application of the word humus was
restricted to that portion of a
soil consisting of the plant
and animal remains, in whatever
stage of decomposition. The proper
designation of these remains is,
however, organic matter.
word humus is still frequently used
In the sense just described the
but not, it is now considered
with correctness and precision.
Humus as now understood by
agricultural chemists represents
a ——— stage in the decomposition
of organic matter in which the
cellular structure has wholly
disappeared and the original substance
is or has been entirely dissolved.

Desert Botanical Laboratory
of the
Carnegie Institution

Since it is often necessary to allude to organic matter in the earlier stage, as distinguished from organic matter as a whole, which includes the humus stage as well, the term structural organic matter is suggested is suggested as a convenient designation. In structural organic matter the cellular structure of the animals or plants still remains and may be detected either by the eye or by the microscope.

Humus does not ordinarily exist in the soil in a dissolved condition but is usually combined with lime or magnesium as calcium or magnesium humates. These are not soluble in water but form a black precipitate, which gives a dark color to the soil.

To extract its humus a soil is first washed with dilute acid, by which the lime, magnesium, or other bas-

(over)

mus-precipitating substance is dissolved and leached away. The humus itself is then removed from the soil by long continued washing with a weak solution, commonly 4% of ammonia.

When this inky black extract is evaporated to dryness the residue is a black substance which when scraped from the dish resembles ~~finely broken~~ coal dust or, even more closely, burned sugar. This substance is humus. It absorbs water readily, assuming the texture of thin jelly. It has a somewhat sooty odor and taste. It dissolves slowly in water, giving the fluid an amber to dark brown color. The solution is slightly acid in reaction. A liter of water in which had been dissolved a gram of humus extracted from kalmia peat showed when tested

? a % normal acidity.

The process of decomposition by which organic matter still retaining its cellular structure is transformed into humus, in which the cellular structure has entirely disappeared, is known as humification.

Humus is rich in nitrogen, but the nitrogen is not in the form of nitrates and therefore cannot be assimilated by ordinary plants. The transformation of humus nitrogen into nitrates occurs during a further process of decomposition known as nitrification.

The nitrification of humus is brought about by certain bacteria which growing in the humus-laden soil under suitable conditions produce first nitrites and then nitrates. In artificial cultures, in addition to proper conditions of temperature, moisture, and good aeration, these nitrifying bacteria require for vigorous growth a neutral or slightly alkaline medium.

In a distinctly acid medium the nitrifying bacteria ~~will not~~ grow little or not at all. In order to ascertain the degree of nitrification, if any, taking place in kalmia peat, the following experiment was made by Mr. Karl F. Kellerman.

Experiment.

~~15. The rootlets of healthy plants of the swamp blueberry are inhabited by a fungus, of the sort known technically as an endotrophic mycorhiza.~~

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18. From the evidence at hand the presumption is that the mycorhizal fungus of the swamp blueberry transforms the non-available nitrogen of peaty soils into a form of nitrogen available for the nourishment of the blueberry plant.

It is a well established principle of plant physiology that only those plants which contain chlorophyll, the green coloring matter of leaves, are able to grow on mineral substances alone, and to put these substances together into organic plant foods. All the plants without chlorophyll, including the fungi, are dependent for the fundamental part of their nourishment on the organic foods originally elaborated from minerals by the chlorophyll bearing plants.

Fungi may be directly parasitic on a clorophyll bearing plant, as in the case of the mildew fungus of rose leaves; or they may grow on substances derived from chloro-

phyll-bearing plants such as bread 2 3
or jelly. ~~or they may grow on animal substances, such as cheese, also derived ultimately from the chlorophyll plant substances eaten by the animal.~~

Fungi are particularly abundant in the decaying vegetable matter forming the leaf litter of a forest, even though this litter may be distinctly acid in its chemical reaction. They are known to grow luxuriantly on vegetable remains containing no nitrates and of such acidity that nitrification of the humus cannot take place.

That the mycorhizal fungi, like other fungi, are able to extract nitrogenous food from the unnitrified organic matter with which their external portions are in contact is a reasonable supposition. It is furthermore a reasonable supposition that the blueberry plant

18. The deficiency of available nitrogen in the acid peaty soil in which the swamp blueberry thrives is due to the inability of the nitrifying bacteria to thrive in such a soil, because of its acidity.

is ____ able to absorb nitrogenous material from the internal portion of its mycorhiza; for we know that the clover plant is able to absorb nitrogen under essentially the same conditions from the nitrogen-fixing bacteria growing in its root tubercles.

To establish by direct experiment the ability of the mycorhizal fungus of the blueberry to act in accordance with the supposition outlined above the fungus should be separated from the plant and grown by itself in suitable nutrient media. Prelim-many trials were made to isolate the fungus, but without success, and a lack of time has prevented thus far the pursuit of that branch of the experiments.

16 ~~17~~. The acid peaty soils in which the swamp blueberry thrives are deficient in available nitrogen although containing large amounts of non-available nitrogen.

p. 24 Copied Dec. 28 19[illegible]

19 It is probable that the mycorhizal fungus of the swamp blueberry transforms the free nitrogen of the atmosphere into a form of nitrogen suited to the use of the blueberry plant.

The fact of the fixation of atmospheric nitrogen by the bacteria inhabiting the root tubercles of clover is now well known, and we are able to understand how the abundant nitrogen of the air, unavailable for the direct nutrition of ordinary plants, is made available for the use of leguminous crops.

It is not so generally known that there are in soils certain species of bacteria not connected with the roots of plants, which also possess the faculty of taking up the nitrogen of the air and transforming it into nitrates. The extent of the distribution of these organisms,

~~16~~ 15. The mycorhizal fungus of the swamp blueberry appears to have a beneficial effect upon the blueberry plant.

Clover bacteria
Azotobacter and Clostridium
Molds.
Tenacity on mycorhizae.
Theory of mycorhizal nutrition

and the amount of nitrogen fixation effected by them are not fully known, but the fact that such action does take place and that the bacteria causing it occur in many localities has been well established by the experiments of several investigators. The bacteria of this class most fully investigated are *Azotobacter chroococcum* and *Clostridium pastorianum*.

It has been shown also that certain fungi, such as

possess this same power of assimilating atmospheric nitrogen.

After the writer had discovered the mycorhizal fungus of the swamp blueberry in December, 1907, and while he was making observations on it, his attention was called to the works of Charlotte Ternetz on the mycorhizal fungi of certain related European plants. Miss Ternetz published in 1904 a

paper* in which she made the pre-

* Charlotte Ternetz, Ph.D. Assimilation des atmosphärischen Stickstoffs durch einen torfbewohnenden Pilz. Ber. Deutsch. Bot. Ges. 22: 267-274. 1904.

liminary announcement that a fungus isolated from the roots of the European cranberry (*Oxycoccus oxycoccus*) had developed pycnidia and that the mycelium produced from spores from these pycnidia, when grown in a nitrogen-free nutritive solution but with full access to air, showed upon analysis that it had assimilated ~~the~~ free atmospheric nitrogen to the extent of .6% of the dry weight of the mycelium. The fungus consumed only one-eighth as much dextrose

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in assimilating a given amount of nitrogen as was consumed by Clostridium pastorianum. Similar but not identical fungi were isolated from other related plants.

In 1907, in a more detailed account of her investigations* Miss

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*Charlotte Ternetz, Ph.D. Ueber die Assimilation des atmosphärischen Stickstoffs durch Pilze. Jahrb. Wiss. Bot. 44: 353-408. 1907

Ternetz described, ~~in detail,~~ as new species of Phoma, five pycnidia-bearing fungi bred from the roots of the European cranberry (Oxycoccus oxycoccus), the marsh rosemary (Andromeda polifolia), two species of heather (Erica tetralix and E. carnea), and the mountain cranberry (Vaccinium vitisidaea). She was unable

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to demonstrate absolutely that these fungi were identical with the endotrophic mycorhiza of the host plants because (1) ~~the~~ it was extremely difficult to observe the fungus threads of the internal mycorhiza grow through the cell wall of the rootlets into the culture medium without, and (2) because when she proposed to inoculate mycorhiza-free seedlings of the host plants with spores from the pycnidia that formed in her cultures she was unable to grow any seedlings that could be kept free from mycorhiza.

Notwithstanding the lack of an absolute demonstration that the nitrogen-fixing fungi grown by Miss Ternetz were identical with the mycorhizal

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fungi of their hosts, the probability of their identity amounts almost to a certainty. It is regarded as strongly probable, therefore, ~~a strong probability~~ ~~There can be little doubt~~ that the mycorhizal fungus that ~~af~~ to occur in perhaps ~~probably~~ all plants of the heather and blueberry families, including the swamp blueberry, are nitrogen-fixers, and ~~that~~ the host plants absorb this nitrogen, giving in exchange, for the use of the fungus, sugar or some other carbohydrate.

The experiments thus far described in the present paper, and the accompanying discussions, appear to warrant the following theory of the method of nutrition of the swamp blueberry:

a. The swamp blueberry grows in peaty soils which contain acid

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or other substances poisonous to plants.

b. As a protection against the absorption of amounts of these poisons great enough to prove fatal this plant, like many other bog and acid soil plants, is devoid of root hairs and consequently has a low capacity for absorbing soil moisture. To accord with its low absorptive capacity it has a reduced rate of transpiration. Many bog ~~shrubs~~ shrubs, although living with an abundant supply of moisture at their roots, have been recognized as showing adaptations for retarded transpiration similar to desert plants.

c. The special danger to which the swamp blueberry is exposed by reason of its low transpiration

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and reduced capacity for absorption is insufficient nutrition, ~~so far as those elements are concerned which are ordinarily absorbed by the plant from the soil.~~ The danger of nitrogen starvation is particularly great since these soils contain very little nitrates.

D. Some bog plants similarly threatened with insufficient nutrition, such as the sundews, the bladderworts, and the pitcher plants, possess means of securing the requisite nitrogen by catching insects, and digesting and absorbing their nutritive parts.

E. In the swamp blueberry the required nitrogen is secured in a different way. The plant possesses a mycorhizal fungus which is able

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~~[illegible]~~ to assimilate nitrogen from the surrounding organic matter and from the atmosphere and to convey it into the plant without taking along with it a large amount of the poisonous soil moisture.

While this theory of the nutrition of the swamp blueberry may not be substantiated in all its details by future investigation ~~[illegible]~~ ~~[illegible]~~, it has afforded a useful basis for cultural experimentation, as will be shown by the results about to be described. ~~[illegible]~~ ~~[illegible]~~

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Cutting 239. No tips withered, but uppermost leaf rudiment standing still in many.

Cutting 240. Tips withered as follows:

A_2 A_3
B_2
D_2 D_3 (blackened)
E_1 (blackened)
G_3

In general the live tips [illegible] somewhat stagnant. [illegible] besides the seven withered [illegible] leave [illegible] though they might wither.

Cutting 241. No tips withered, many stagnant.

Cutting 242. Tips withered as follows:

E_3 (blackened?)

Many tips stagnant. ~~[illegible]~~

[illegible]

Cutting 237. Tips withered: | Cutting 240. Tips [illegible]:

A_3
B_1 B_2
C_1 C_3

A_2 A_3
B_2 B_4
D_2 D_3 (blackened)
E_1 (blackened), F_2
G_3

Cutting 238. Tips withered: | Cutting 242. Tips withered:

B_2
E_1

A_3
B_2
E_3 (blackened)

Cutting 239. Tips withered: | Cutting 241. Tips withered:

G_2

None.

(Compt. Rend. 116: 1385-1388) Dec. 31, '30.

In 1893 Winogradsky announced the discovery of a soil microbe shown by his experiments to be possessing the power to assimilate free atmospheric nitrogen.

In 1894 (Compt. Rend. 118: 353-355) he published an additional note on the same subject.

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[illegible] [illegible] [illegible].

Culture 73. Eighteen drained glasses of thumb pot size, ~~[illegible]~~ 6 [illegible] [illegible] with [illegible], 6 with [illegible], in a soil containing [illegible] [illegible] & [illegible], [illegible] sand 1 [illegible], clay loam 1 part.

Culture 74. Same as 73, with half the [illegible] the [illegible] [illegible] of [illegible] rotted [illegible] [illegible] [illegible]. Six [illegible] plants.

[illegible] 75. Same as 73 with a [illegible] of [illegible] bulk of [illegible] [illegible]. Six plants.

75a. Same as 73, with [illegible] [illegible]

Culture 76. Same as 73, with 1% carbonate of [illegible] added. Six [illegible].

Culture 77. Rose soil [illegible] (Mr. [illegible]. [illegible] consisting of clay loam [illegible] [illegible], [illegible] rotted ~~unleached~~ cow manure 1 [illegible] [illegible] [illegible] [illegible] [illegible]. Six [illegible] [illegible] plants, 6 [illegible] [illegible] [illegible] plants.

Culture 78. Silver sand [illegible] [illegible] slightly [illegible] [illegible] [illegible]. Six plants.

Culture 79. [illegible] [illegible] [illegible] [illegible] [illegible] slightly [illegible] [illegible] [illegible] [illegible] plants

Culture 80. [illegible] [illegible] [illegible]

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Experiments. 1908-1909

Take a blueberry plant growing thriftily in a suitable acid soil, and with mycorhiza in abundance on its roots. (Make bacterial tests if practicable.)

Water with a very weak alkaline solution, preferably lime, and watch the effect on the mycorhiza and on the plant, making also bacterial tests from time to time. The question is, Does the growing alkalinity of the soil affect the plant directly or through ~~the~~ a deleterious action on the mycorhiza

Culture 81. Silver sand. Drinking glass cultures. Six plants.

Culture 82 Same as 81, with peat mulch added after the plants are well and uniformly established in the sand. Six plants.

Culture 83. Same as 81, overlain by growing sphagnum, but the sphagnum not added till the plants are well and uniformly established. Six plants.

Culture 84. Clay loam. Six plants

Culture 85. Same as 84, with peat mulch.

Culture 86. Same soil as 73. Six plants.

Culture 87. Same as 86, overlain by growing sphagnum.

Experiments proposed

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